# Municipal Engineering.

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## THE GRADE CROSSING QUESTION.

THE city of Birmingham, Ala., recently had a discussion of the relative rights of the public and of the railroads regarding the abolition of grade crossings, which has resulted in a careful collection of the authorities on the subject, with citations of constitutional and statute provisions and of court decisions.

We are indebted to the city attorney of Birmingham, Romaine Boyd, for an opportunity to take advantage of the work done by the attorneys in collecting these authorities as an aid in preparing this statement of the present state of legislation and judicial decisions, which is somewhat limited, perhaps, by the conditions of the particular case under consideration.

Fifteenth avenue is a street platted before the railroad tracks were laid across it, but seems not to have been used heretofore. It is the only crossing in about a half mile. A new boulevard has been donated to the city and will be improved by a realty company, access to which, and to the platted area belonging to the realty company, is more direct by this route and will be much safer if the grade crossing is eliminated. The newly platted area is as yet not settled upon and the probable increase in traffic over the railroad crossing has not yet taken place. The realty company has petitioned for a subway at Fifteenth avenue. There is a viaduct over the tracks at Twelfth avenue, constructed and maintained by the railroad company as required by the city.

Constitutional provisions of Alabama, which are quoted, are those giving the legislature power to alter, amend or repeal all acts which it may pass, and to alter, revoke or amend any charter of incorporation existing and revocable when the constitution was adopted or created thereafter, when it may be deemed injurious to citizens of the state, but that no injustice shall be done to the corporators. The opinion of Chief Justice Fuller of the United States Supreme Court is quoted that "the inhibitions of the Constitution of the United States upon the impairment of the obligations of contracts or the deprivation of property without due process or of the equal protection of the laws by the States are not violated by the legitimate exercise of legislative power in securing the public safety, health and morals," and that "a power reserved to the legislature to alter, amend or repeal a charter authorizes it to make any alteration or amendment of a charter granted subject to it, which will not defeat or substantially impair the object of the grant, or any rights vested under it, and which the legislature may deem necessary to secure either that object or any public right." (N. Y. & N. E. R. R. Co. v. Bristol, 151 U. S. 566); also from Justice Harlan that "the power, whether called police, governmental or legislative, exists in each State, by appropriate enactments not forbidden by its own constitution or by the Constitution of the United States, to regulate the relative rights and duties of all persons and corporations within its jurisdiction, and therefore to provide for the public convenience and the public good." (Lake Shore, etc. Co. v. Ohio, 173 U. S. 285, 297.)

Alabama statutes referred to confer on Boards of Public Works the exclusive power, control and supervision of the city streets (Sec. 1241); on cities the right to provide for safety, and improve order, comfort and convenience of inhabitants (Sec. 1251); on the city council the right to require any public utility to render streets used by it safe to vehicles and persons and to fix grades of all tracks on such streets and to change the grades without expense to the city (Sec. 1269); and to require railway companies to construct and maintain viaducts, bridges and tunnels, or parts thereof, and approaches over, along or under their tracks at their own expense (Secs. 1296 to 1301); and prescribe methods of enforcement of the ordinances. Connecticut has a similar statute, passed June 19, 1889, which has

been held by its Supreme Court as amending the charters of railroad companies affected by it, and has been held by the United States Supreme Court in the Bristol case above referred to as within the power of the State in its police duties in abating nuisances, etc. The court also holds that the legislature can require either party to pay all or any part of the expense. Mississippi has a statute prescribing that the raising or lowering of a highway to abolish a grade crossing must be done by the railroad, which was sustained by its Supreme Court in Illinois Central R. R. Co. v. Copiah County, 33 So. 502.

Many decisions are quoted where, in absence of direct constitutional or statutory provisions governing the matter, the courts have held that the burden of eliminating grade crossings is wholly or largely upon the railroad company. They are briefly stated in the following paragraphs:

The Supreme Court of Georgia, in Cleveland, Receiver, v. City Council of Augusta, 43 L. R. A. 637, states that the railroad constructs grade crossings on the implied condition that it will yield to reasonable burdens imposed by the growth of the neighborhood and must make alterations or separations of grades at its own expense.

The Supreme Court of Illinois, in C. B. & Q. R. R. v. People, 72 N. W. 219, states that the railroad company is bound to make and keep its crossings at its own expense in such condition as shall meet all reasonable requirements of the public as the changed condition and increased use may demand. There was a similar decision by the United States Supreme Court in C., B. & Q. R. R. v. Drainage Commissioners (in Illinois), 200 U. S. 561, in which this principle is extended to cover the change in bridge made necessary by an improvement in a drainage channel, and reference is made to C., B. & Q. R. R. v. Chicago, 166 U. S. 226, in which case it was held that uncompensated obedience to a regulation enacted for the public safety under the police power of the State was not taking property without due compensation.

Indiana cases are Lake Erie & Western R. R. Co.. v. Cluggish, 143 Ind. 347, in which the railroad's duty to restore a stream or highway crossed by its line is stated to be a continuing one, and it must make such alterations from time to time as will meet the increasing needs of the public; and Indiana v. L. E. & W. R. R. Co., 83 Fed. Rep. 284, 287, in the decision of which Justice Harlan says that "the police power of a State embraces regulations designed to promote the public convenience or the general prosperity as well as regulations designed to promote the public health, the public morals or the public safety," and "the validity of the police regulation, whether established directly by the State or by some public body acting under its sanction, must depend upon the circumstances of each case and the character of the regulation, whether arbitrary or reasonable and whether really designed to accomplish a legitimate public purpose.

In Louisiana, in New Orleans Gas Light Co. v. Drainage Commission, 197 U. S. 453, the gas company was declared to have the use of the streets only and the city could later use the streets for its own purposes and the gas company must move its pipes to new and convenient locations for the city's purposes at its own expense.

In Massachusetts, as against the contention that the duties of the railroad were limited to those existing at the time the road was built, it was decided in Cooke v. Boston & Lowell R. R., 133 Mass. 185, 188, that the legislature intended the provision of safe and convenient use of the highway to apply for all time and that increasing use of the highway lays additional duties upon the railroad and it must make such alterations as the present needs of the public demand.

In Michigan, the court held in Attorney General v. Fort Street Union Depot Co., 76 N. W. 85, that the necessities for public safety must exist before overhead structures at crossings can be required. Similar opinions will be found in Mayor, etc., of Newark v. Erie R. R. Co. (N. J.), 68 Atl. Rep. 413, and State ex rel. St. Paul v. Minn. Transfer Co. (Minn.), 83 N. W. 32.

In Minnesota, the Supreme Court in State v. St. Paul, etc., R. R., 35 Minn. 131; 28 N. W. 3, says that the railroad must keep its street crossings so as not to impair or interfere with their free and proper use, by carrying their tracks over or under the highway or the highway over or under the tracks, if it cannot be done without, including all that is necessary to be done to accomplish this result. In the case of the Northern Pacific R. R. Co. v. Duluth, 208 U. S. 583, the railroad company was compelled to assume perpetual maintenance of a viaduct and approaches which was originally constructed and paid for, by agreement, part by the company and part by the city. In this decision reference is made to 98 Minn. 380, for a decision that the police power is a continuing one and cannot be contracted away and a railroad company can be required to improve its street crossings without compensation, without violation of the constitutional provisions regarding taking of property without compensation, and impairment of obligations of con-

tracts. The whole subject is discussed and principles are reaffirmed in State ex rel. Minnesota v. St. Paul, etc., R. C. Co., 28 L. R. A. (N. S.) 298, which was affirmed by the United States Supreme Court in 214 U. S. 297.

In a New York case, Village of Carthage v. Frederick, 122 N. Y. 268, it is stated that compensation has never been a condition of the exercise of the police power, even when attended with inconvenience or peculiar loss, and that if the injury complained of is only incidental to the legitimate exercise of governmental powers for the public good, then there is no taking of property for the public use, and a right to compensation on account of such injury does not attach under the constitution.

A Pennsylvania case is very recent, Cincinnati, etc., R. R. Co. v. Connellsville, 218 U. S. 336, in which Justice Harlan concludes that there was no error in holding that the city could not be compelled to reimburse the railway company for the cost of the bridge which it required the company to build in an embankment, so as to open a street across the railroad on a high fill.

These decisions give ample authority for most of the contracts that are made between municipalities and railroads from time to time for track elevation and grade separation and to legislatures of the States which have passed laws distributing the cost between the parties involved, city, county, State, railroad company, street railroad company, etc. There are many such special laws which are not covered by the investigation above sketched, which was based on general constitutional and common law rights and certain limited statutes of the State of Alabama.

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# PRACTICAL ROAD BUILDING.*

By John N. Edy, Jun. Am. Soc. C. E., Asst. City Engineer, Billings, Mont.

## CULVERTS.

THE question of culverts must be considered from three different standpoints—size, location and material. The size will be determined by the volume of water to be cared for, which is dependent upon the rainfall, the area drained, the porosity of the soil and the slope of the land. Obviously an investigation to determine these different factors will be without the sphere of the supervisor. He must, however, make some effort to estimate the size of the opening required in order that the culvert may give good service. Different formulæ have been devised for approximating the area of waterway required, but they are all more or less of a guess. However, about the only way in which to designate the size of the opening required is by means of one of these scientific guesses. This fact is to be noted: It is possible and reasonable to increase the capacity of a culvert by laying it on a grade, instead of level. For instance, the discharge of a 24-inch pipe laid on a grade of 3 per cent., or 3 feet in 100 feet, is more than 5 times as great as when laid on a grade of 1 inch in 100 feet. In other words, the grade of the pipe is of more importance than its size. This feature may be observed in box or arch culverts, by laying a floor to the desired grade. In the case of existing culverts, therefore, the known and observed volume of water is of great value, in that it shows the discharge under the given conditions of grade, shape, etc. If a culvert is to be built to carry a given maximum volume of water flowing on a grade less than 3 per cent., it is obvious that an opening of the same area laid on a grade of 3 per cent. will carry more water. The supervisor must not lose sight of the fact that local conditions invariably determine the opening required, and any suggestions given must be used only upon considering these local conditions.

Tables have been presented for waterway area necessary for a given drainage area that do not take account of this feature of culvert grade. It is plain, that inasmuch as an increase in the size of culvert materially increases the cost, every effort should be made to provide a suitable culvert at a reasonable expense. One of the best known formulas for estimating the culvert area required is that devised by Professor Talbot, and is

$$A = C D^{\frac{3}{4}}$$

In which A equals the area of culvert opening required, in square feet; C equals a coefficient determined by the nature of the watershed, and D equals the drainage area in acres.

Assigning suitable values for C, and different values for D, a table has been computed showing the opening required for given drainage areas under all conditions of topography, from "prairie" to "very mountainous." From this table it is

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seen that the culvert opening required for run off from a given area in very mountainous country, is about four times that required for the same drainage area of rolling land. The writer believes that by adopting a size of opening that would answer for the last condition, and then laying this culvert on a 3 per cent. grade so as to increase the discharge, variations in topography as well as in rainfall may be overcome. The following table, used in connection with local data, should be of value in determining the proper size of opening for different drainage areas.

STANDARD CULVERT OPENINGS.

Laid on grade of 3% or

6-in. fall in 16 ft. 7½-in. fall in 20 ft. 9-in. fall in 25 ft. 11-in. fall in 30 ft.

D equals drainage area in acres.
A equals opening required in sq. ft.

| D. | A. | Culvert Suggested |
|---|---|---|
| 5 ..... | 0.8.....1 | 12 in. pipe |
| 10 to 20 | 1.4 to 2.4.....1 | 18 in. pipe |
| 30 ..... | 3.2.....1 | 24 in. pipe |
| 40 ..... | 4.0.....1 | 27 in. or 2 18 in. pipes |
| 60 ..... | 5.4.....1 | 30 in. or 3 18 in. pipes |
| 80 ..... | 6.7.....1 | 36 in. or 2 24 in. pipes |
| 100 ..... | 7.9.....2 | 27 in. pipe or 2 ft x 4 ft. box |
| 150 ..... | 10.6.....2 | 30 in. pipe or 3 24 in. pipe |
| 200 ..... | 13.3.....2 | 36 in. pipe or 3½ ft. x 4 ft. box |
| 260 ..... | 16.2.....3 | 30 in. pipe or 4 ft. x 4 ft. box |
| 300 ..... | 18.0.....3 | 36 in. pipe or 4 ft. x 5 ft. box |
| 400 ..... | 22.3..... | 5 ft. x 5 ft. box or arch |
| 600 ..... | 30.3..... | 6 ft. x 6 ft. box or arch |
| 800 ..... | 37.6..... | 6 ft. x 7 ft. box or arch |
| 1,000 ..... | 44.4..... | 6 ft. x 8 ft. box or arch |
| 1,200 ..... | 51.0..... | 7 ft. x 8 ft. box or arch |

Whether or not the boxes may be used as given depends on the head room. Furthermore, for large drainage areas there will often be other limiting conditions that fix the span.

*Location.*—Too often the supervisor will place a culvert to carry water across the road, altho by so doing he will not waste it any quicker. The object in using a culvert is to get the water away from the roadside, and not merely transfer it from one side ditch to the other. A culvert should be placed only where it is needed, and an effort made to relieve the side ditch by carrying the water under the road, at frequent intervals, to an outlet. For this purpose the small pipes (not less than 12 in. diam.) are acceptable. On grades, the culvert should not cross the road at right angles, but diagonally, the entrance end extending up the grade.

Occasionally small boxes are used to serve a drain that crosses the roadway several times in a short distance. This practice is expensive, and may be avoided by straightening the channel and using one crossing. Culverts should be placed thru all embankments not otherwise drained. Water coming onto the right of way should not be carried in the side ditches for any great distance, except as mentioned above, to avoid unnecessary culverts. At cross-roads it is often desirable to produce the side ditch of one road by means of a culvert under the other. In this case it is not necessary to use as great culvert area as that of the side ditch, unless it is impossible to work to an approved grade, which might be true in flat country. Before definitely placing any culvert, if any choice of location is offered, the foundations should be carefully examined.

*Material.*—We are all very familiar with the wood-box culvert. Certainly such makeshifts are built without regard for service or economy. And because timber is becoming scarce and expensive, its use in culverts can no longer be justified on the basis of low first cost. Tables have been computed showing the cost at the end of long periods of time of culverts built of different materials. These computations clearly demonstrate that timber is by far the most expensive material that may be used for the purpose. This is very evident when one considers that the ordinary wood box must be rebuilt about every five years, while concrete, for instance, is absolutely permanent. Thus if culverts of wood and concrete for the same location cost $25.00 and $100.00 re-

spectively, at the end of 20 years they have cost the same, at the end of 40 years the wood is twice as expensive as concrete, not counting interest on the investment. Furthermore, the permanent culvert gives permanent service, while the other is constantly in need of repair and attention.

The life of different culvert material has been variously estimated, the following being an example:

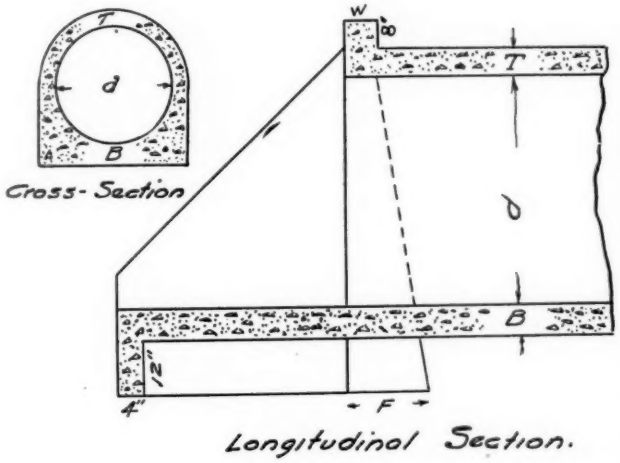
| Material. | Life in Years. |
|---|---|
| Timber | 5 |
| Steel | 20 |
| Corrugated iron | 20 |
| Vitrified clay | 50 |
| Cast iron | 80 |
| Stone or concrete | 100 |

The last two materials may last indefinitely. It is usually easier to find good concrete stone than good building stone; and concrete is by far the most desirable material for those localities wherein good gravel may be obtained.

Concrete culverts may be built of plain or reinforced concrete and may be either circular or rectangular in cross section. Figs. 1 and 2 show a good design for a plain circular culvert with dimensions for the culvert proper and the end walls.

Culverts of this type are readily built, using some kind of collapsible form, preferably of steel. These forms are easily adjusted, and may be used any number of times. A good collapsible wood form may be made as follows: A number of 2x4s are beveled by ripping along each 2-inch edge until one side is 3¼ inches wide, the other being 4 inches. These are laid side by side and fastened together on the 4-inch side with heavy wire. The number of pieces of 2x4 in. will vary with the diameter of the culvert; a 24-inch opening requiring 19 pieces, and a 30-inch opening requiring 24 pieces. The form may be of any desired length, 10-foot sections being very satisfactory. The bound 2x4s are then rolled about circular wooden heads, the diameter of which is 4 inches less than that of the culvert. When placed in the trench the form is held in place by means of small wedges.

To build a culvert, first make the excavation to grade, and of such width that the vertical sides of the trench may be used as outside forms. These sides must be smooth and uniform. The bottom of the trench must be carefully graded, and the bottom material should be well




Barrel.

| d | T | B | Cu. Yd. per ft. |
|---|---|---|---|
| 12" | 2" | 4" | 1.0 |
| 18" | 3" | 4" | 2.0 |
| 24" | 4" | 4" | 3.2 |
| 30" | 4½" | 6" | 5.0 |
| 36" | 5" | 6" | 6.4 |
| 42" | 5½" | 6" | 8.0 |
| 48" | 6" | 6" | 9.7 |

End Str's.

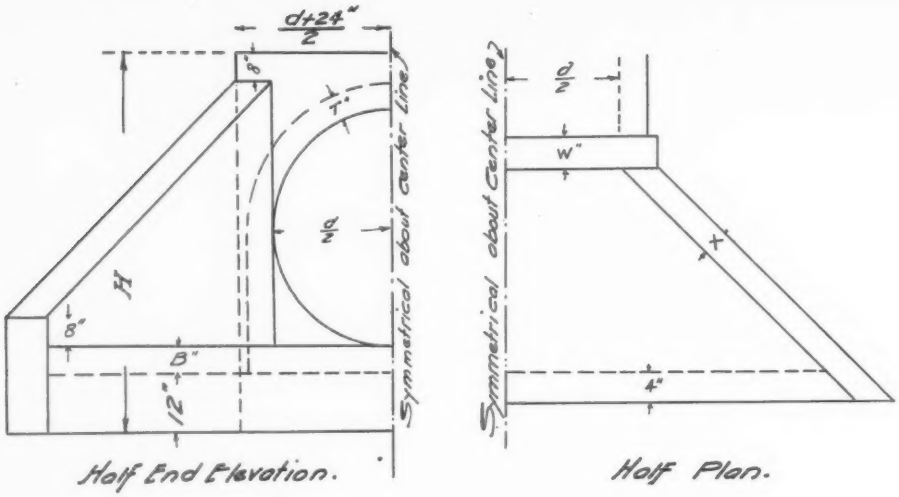
| H | W | F | X |
|---|---|---|---|
| 2' | 6" | 9" | 6" |
| 3' | 6" | 9" | 6" |
| 4 | 6" | 12" | 6" |
| 5 | 9" | 15" | 9" |
| 6 | 9" | 18" | * |
| 8 | 9" | 24" | * |
| 10 | 9" | 30" | * |

Table of Dimensions of Reinforced Concrete Culverts.

* These wings to be adopted only when high "W" and "F" are required at the ends.

PLAIN CONCRETE CULVERTS.

tamped, all soft or spongy earth being removed. It is essential that the subgrade be solid and compact, or there will be settlement, which means destruction to the culvert. The subgrade having been properly graded and compacted, the concrete floor or base is placed in the bottom of the trench, placing a somewhat greater depth of concrete than the final thickness as shown in the table. Set the collapsible form on the newly placed base, and work it down into the concrete until the correct thickness of floor is attained. The concrete side of the forms should be oiled before using. The rest of the concrete is then put about the form and allowed to set, after which the form is removed by knocking in the heads and



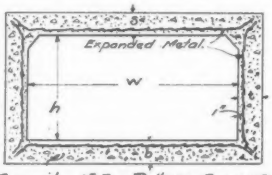

## PLAIN CONCRETE CULVERTS :- END WALLS.

drawing out at the end of the culvert. Headwalls and wingwalls may be readily built as shown in the plans, using well-braced 1-inch lumber for forms.

Concrete pipe or flat slabs are sometimes molded in the shop and hauled to the culvert site. When this is done the structure should be reinforced, so as to reduce its thickness and weight. Concrete boxes are usually made in place, the method being substantially as follows: Make the excavation and prepare the subgrade as previously noted. Place in the bottom of the trench a floor of concrete, as shown in Fig. 3, smoothing with a trowel. Particular attention is to be given the matter of grade; this may be done by leveling across from one side of the road to the other with a carpenter's level, and dropping the outlet end until the required fall is obtained. If the sides of the trench are firm and even no outside forms will be required; the side walls should in this case be made a little thicker to allow for inequalities. The inside form, which is placed on the fresh concrete floor, consists of two sides and a top, of the proper dimensions as determined by the opening. The side forms may be braced together, and held in place with small wedges; the top piece is not nailed, being held in position by means of rectangular wooden headers, so that when the headers are knocked out the form collapses. The concrete is placed in the side wall forms and to a depth of one inch over the top, when the reinforcement is placed. The remainder of the slab is concreted, smoothed with a trowel, and left to harden.

Fig. 3 shows a box culvert, the dimensions of which may be taken from the accompanying table.

*Design of Reinforced Concrete Box Culverts using Northwestern Expanded Metal, Uniform Standard.*



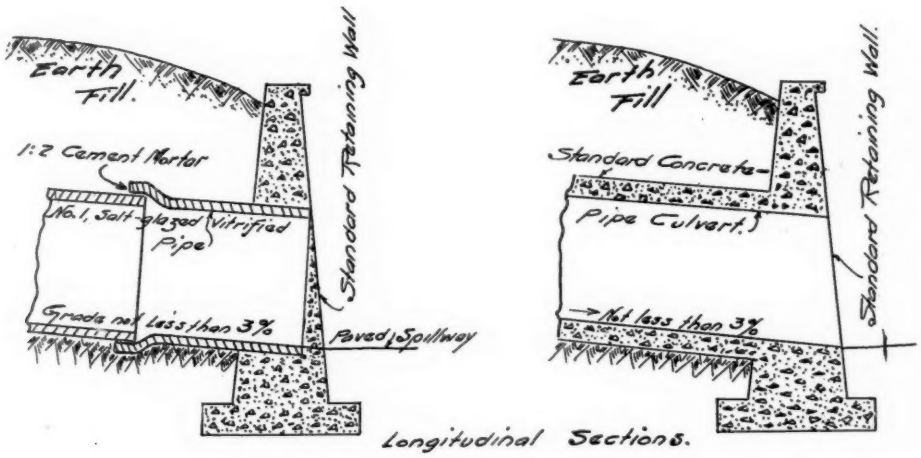

*Capacity 15 Ton Roller : Concr. 1:2:4½*

| h' | w' | Slab s | Slab Reinf. | Side walls t | Side walls Reinf. | Bottom b | Bottom Reinf. |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 4 | 25-3 | 6 | None | 4 | None |
| 1 | 2 | 5½ | 40-3 | 6 | " | 6 | " |
| 1 | 3 | 6 | 30-3 / 20-3 | 6 | " | 6 | " |
| 2 | 2 | 5½ | 40-3 | 8 | " | 6 | " |
| 2 | 3 | 6 | 30-3 / 25-3 | 8 | " | 6 | " |
| 2 | 4 | 7 | 20-3 / 20-3 | 8 | " | 7 | 40-3 |
| 3 | 3 | 6 | 30-3 / 20-3 | 8 | " | 6 | None |
| 3 | 4 | 7 | 40-3 / 20-3 | 8 | 25-3 | 7 | 40-3 |
| 3 | 5 | 8 | 40-3 / 25-3 | 8 | do | 8 | do |
| 3 | 6 | 8½ | 40-3 / 30-3 | 8 | do | 8 | do |
| 4 | 4 | 7 | 40-3 / 20-3 | 8 | do | 7 | do |
| 4 | 5 | 8 | 40-3 / 25-3 | 8 | do | 8 | do |
| 4 | 6 | 8½ | 40-3 / 30-3 | 8 | do | 8 | do |
| 4 | 8 | 10 | 40-3 / 40-3 | 10 | do | 10 | do |
| 5 | 8 | 10 | 40-3 / 40-3 | 10 | do | 10 | do |
| 6 | 8 | 10 | 40-3 / 40-3 | 10 | do | 10 | do |

*Note: For Exp. Metal may be substituted the bars shown in table "Reinforced Concrete Slabs". Minimum fill of 12" on all Culverts.*

Wingwalls and headwalls should be built on all culverts, and they are built as shown in Figs. 1, 2 and 3. Headwalls must be constructed on all forms of pipe as well as other culverts. A cut-off wall extends below the floor of the culvert to prevent water washing underneath; the wingwalls are shown extending well below the surface of the ground for the same purpose. The spillway or apron catches the water as it leaves the outlet end, and prevents cutting. These precautions should not be disregarded. They entail but slight additional expense and add materially to the permanence of the structure.

In making a culvert of any kind of pipe, the trench must be excavated to the exact shape of the pipe, cutting away a




CONCRETE END-WALLS FOR PIPE CULVERTS

from "Plain Concrete Bridges and Culverts"

place for the bell, which is always placed upstream. Vitrified clay or concrete pipe make very satisfactory culverts, but may be laid only on a firm and compact foundation, and must have the joints made watertight with 1:2 cement mortar. Care must be exercised in backfilling and tamping the earth so as not to injure the pipe. For such a culvert the headwalls and spillways may be built of large flat stone laid in cement mortar; however, concrete-end structures, as shown in Fig. 4, are more desirable for this purpose. All culverts must be sufficiently long that a perfectly safe road may be carried over them; 16 feet should be the minimum length. The end or headwalls are to be carried up above the roadway to form a protection, as well as to hold the material in place. When two or more parallel lines of pipe are used for one culvert, their adjacent sides should be separated at least 6 inches, this space to be filled with thoroly tamped earth. Parallel lines of circular concrete culverts made in place may be monolithic. Culverts should be so designed that there will be sufficient covering over the top (at least 18 inches) without sharply raising the grade of the road at that point. A "hump" over a culvert is unsightly, may be dangerous, and damages both the road and culvert.

While the writer advises against the use of timber in culvert construction, he realizes that occasionally such a temporary structure is a necessity. In that case the supervisor must endeavor to build the best he can under the conditions. Wood boxes placed under the ground where they are alternately wet and dry, are only temporary, and very expensive. Furthermore, because it is impracticable to place such a box on a given uniform grade, the opening must of necessity be larger than would be required for a culvert of permanent material with which an advantage of grade may be taken. No perishable material should ever be put under the ground where it cannot be inspected and repaired.

Culverts and bridges should be regularly inspected so that at all times they may be free from obstructions. Structures of permanent material require no repairs, but the earth or macadam covering must be replaced as it wears out.

# THE SEWERAGE SYSTEM OF BALTIMORE.

By Stuart Stevens Scott.

BALTIMORE'S sanitary sewerage system, which is being installed at a cost of upwards of $14,000,000 and which has presented some of the most difficult and unique engineering problems, is now about one-half completed. Already, however, a considerable portion of the completed system is in actual use and as fast as sections are ready, the connections with houses are being made. The sewerage commission in a recent report states that the entire work will be completed in 1914.

The work of constructing is particularly interesting because of its magnitude and difficulty. It has been the purpose of the engineers to rely, as much as possible, upon gravity. This means that an 8-inch sewer beginning at Forest Park, a suburb to the northwest of the city and 13 miles from the disposal plant, must continue on a constantly falling grade, which cannot be flattened beyond certain rates, ever increasing in size as sewers lead into it from valleys and hills covering 32 square miles.

From Forest Park this main sewer crosses a stream, goes under the B. & O. railroad tunnel, over another stream at one point, and under the same stream at another point, goes under the Pennsylvania railroad tunnel, crosses ravines, swings around hills, goes through ridges, through narrow valleys, by the side of tall buildings, its size steadily increasing until, at the disposal plant, it is large enough to contain two automobiles, one on top of the other.

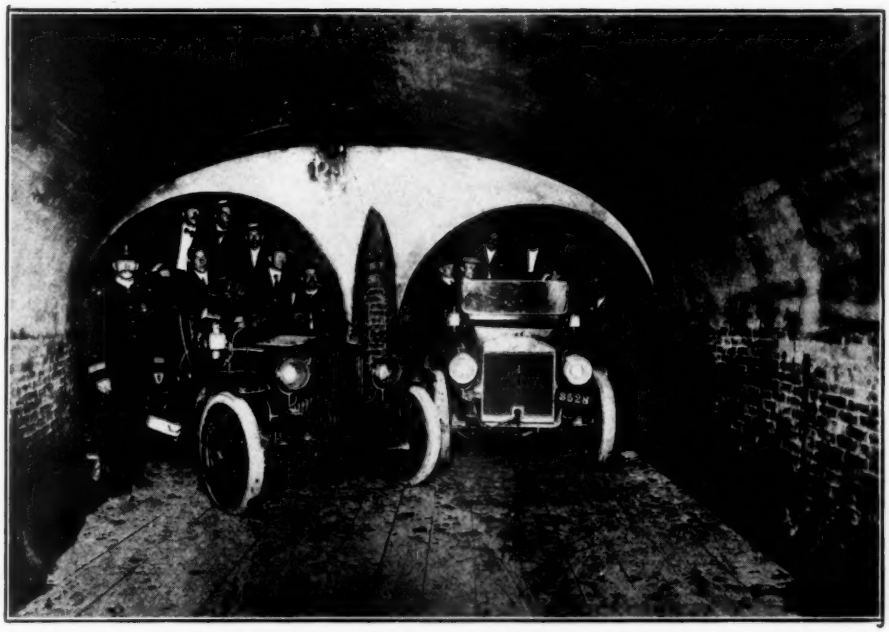
The system as planned provides that two-thirds of the sewage of the city be intercepted and carried to the disposal plant by gravity; the other third to be lifted by pumps, each with a capacity of 7,500,000 gallons a day, from a point 13 feet below tide to the out-fall sewer, a height of 72 feet, including friction. This is an unusually heavy lift, especially as sewage is more difficult to pump than water. Three of these pumps are now ready for service in the pumping station, which is large enough to contain two more to be installed later. The foundations for these pumps are independent of the foundation of the building.

The difficulty of the construction work is doubled on account of having to build two complete systems of sewers and drains, which cross and re-cross each other at a thousand diffierent places. The necessity for the double system is that the legislature requires every gallon of sewage taken into the sanitary system to be purified before discharging it into the Chesapeake Bay or its tributaries. It was therefore of vital importance that the amount of sewage to be pumped and treated be reduced to a minimum in order to keep down the size of the sewers, pumping station, the disposal plant and the unnecessary constant treating and pumping of clear rain water.

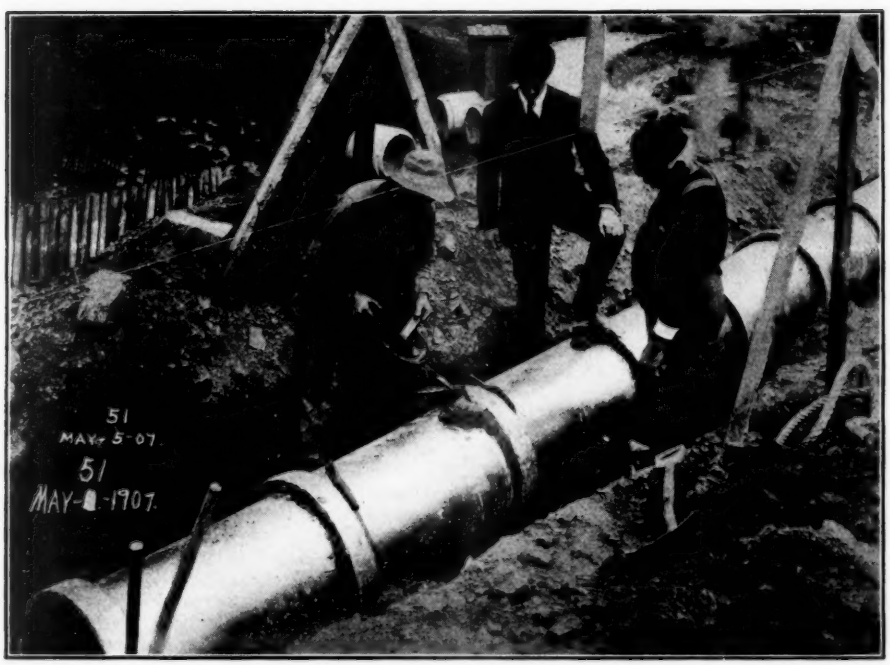
The only way to separate the rain water from the sewage, was by the construction of two independent systems. Therefore, the sanitary sewers will take care of the drainage from bath tubs, kitchen sinks and toilets. The rain water will pass off through storm water drains by inlets at street corners. To install these two systems in the beds of streets of a city more than a hundred years old, in which a mass of pipes had been laid, but in which practically no space was left for the sewers or drains, brought the engineer face to face with a series of problems as complex as they were varied. If the sewers could be laid in the streets, matters would be simplified, but with an eye to saving money for the house-holder, who has to pay individually for the connections, the engineers selected the alleys.

In these narrow thoroughfares not only is there a lack of room, but the workmen are continually hampered by a constant surface flow from kitchen sinks and bath tubs, of leaking water pipes and old sewers. More than that, the new sewers pass close to old brick buildings on shallow foundations and the owners of these buildings are ever alert to find cracks alleged to have been caused by the new construction work. In this respect the engineers have been wide awake. They have a photographic department and before any excavations are made the walls of buildings along the line are carefully examined and wherever a crack in the brick work is noticed, it is photographed. These photographs have played an important part in settlement of contentions of owners who have sought to blame the engineers for something for which they were not responsible.

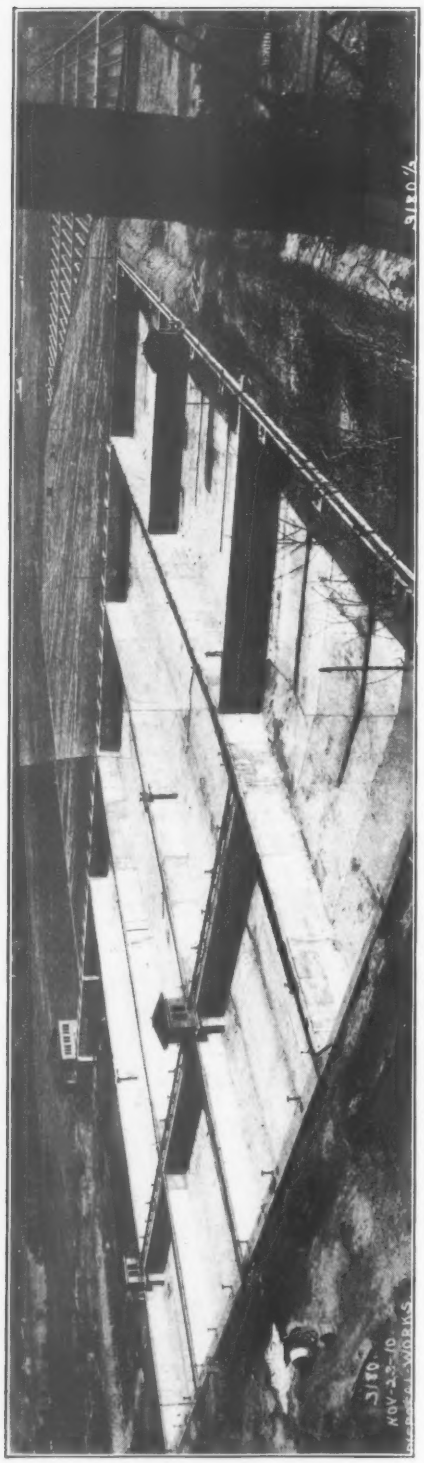
In the section of the city around the water front the difficulties were materially increased by having to work below tide level and hundreds of feet of cofferdamming had to be built. The sewers completed and the sections under contract measure about 160 miles and a goodly portion of them are large enough to drive thru in automobiles; indeed not long ago the Governor of Maryland, the Mayor of Baltimore, the members of the



**THE BALTIMORE SEWERAGE SYSTEM.**
**Branches Joining Five-Mile Main Sewer.**




**THE BALTIMORE SEWERAGE SYSTEM.**
**Jointing Small Pipe Sewers.**



THE BALTIMORE SEWAGE DISPOSAL PLANT. Sludge Tanks in the Foreground and Filters in the Rear.

sewerage commission and about fifty guests made such a trip from the outfall end, nearly six miles under ground.

A peculiar feature in connection with the sewerage work is that the greater percentage of visitors are from out of Baltimore. Engineers from all parts of Europe and even China have visited the great disposal works and splashed thru miles of mud to see just how the work is being carried on. A most important feature, from an engineering point of view, is the method by which the work has been divided into sections, each section being considered a unit.

The disposal plant is constructed on the unit system so that it may be added to as the sewerage system is extended. The units so far completed are sufficient to take care of a population of 75,000. The units will be increased until they can take the sewage from a million population.

The method of treating the sewage is as follows:

At the mouth of the outfall sewer are installed screens that catch such things as sticks, rags, etc., which will be removed and burned. The sewage then passes thru the meter house, which measures its flow; then thru hydrolitic tanks, about 450 feet long, requiring 8 hours for passage—a sufficient length of time to allow the solids to settle, the liquids passing on thru an intercepting channel to and thru what is called the gate house, which distributes it to the stone sprinkling filters, located at a level of 15 feet below the hydrolitic tanks, giving a hydraulic head of sufficient force to spray the sewage over these stone beds thru nozzles, or jets, spaced 15 feet apart. The hydraulic head will be controlled by butterfly valves, causing the sprays to rise and fall, varying from close to the nozzles out to the limit of 15 feet, thus utilizing the entire surface of the stone bed, a large portion of which would be wasted if the sprays were stationary. These nozzles will throw a square spray, thereby saving additional space which would be lost if the sprays were circular, as where circles touch there is a lost triangle.

The spraying of the sewage thru the air is essential to the aeration and purification of the sewage. As the sewage falls on the stone beds it trickles down thru 8½ feet of broken stone, varying in size from 1 inch to 2½ inches. The passing of the sewage thru these beds forms a gelatine-like film on the stones, in which certain bacteria multiply in the sewage.

On reaching the bottom of the stone beds, the sewage is practically pure. It is then carried by intercepting channels to a central channel under the stone beds, which finally delivers the purified sewage to the settling basins where it requires three hours to pass thru. These settling

basins are not for the purpose of causing additional purification, but to clarify the fluid, as there are certain mineral substances in the sewage which the bacteria in the stone beds do not annihilate, such as are found in the Mississippi river water, which is muddy, but not injurious to drink.

The sewage then passes with a drop of 18 feet to the power house, in which turbines are placed, operated by the flow of the sewage. They in turn run dynamos which generate electricity, giving power to light the plant, run the sludge pumps and lift the clarified sewage to a water tower for flushing purposes. In other words, by the simple gravity flow of the sewage, it is purified and power is obtained to light and run the plant at practically no cost.

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## A GERMAN TAR AND CEMENT PAVEMENT.

**By Dr. Robert Grismhaw, Dresden, Germany.**

EXPERIMENTS have been made in Bremen and elsewhere with a street pavement composed principally of tar and cement, and which for one reason or other has been baptized "Terbacca," which has to American ears a familiar klang, not entirely suggestive of street paving.

A test section at the Oldenburg freight station shows, after two years' heavy traffic, but little surface wear and no cracks, altho laid on filled ground. The surface layer remains plain and level and shows less wear than the adjoining sections, which are stone paved on a sand bed and which are more uneven, showing in many places considerable ruts.

The tar-cement pavement is laid on a bed of 5 to 6 inches of beton, or over broken stone slicked with cement mortar, say, about 2 to 3 inches for ordinary streets, ¾ to 1½ inches for foot pavements and 1¼ to 2 inches for courts. The mixture is made up of 90 volumes of hard broken stone of three different sizes, 10 of gravel and sand, and 40 to 60 of Portland cement, mixed dry, then 10 per cent. of water is added and at least five parts of coal tar, thinned down with a solvent. The tar-cement mixture is laid on much more thickly than required finally and tamped down with a six-pound rammer to the required thickness. Where grades are unusually steep, more cement is used than on levels.

To prevent the formation of cracks, it is sufficient in ordinary climates to leave openings of ⅝ inch every 40 feet, filling these with asphalt.

In Gothenburg, Sweden, and on the Kaiserstrasse in Hagen, Westfalia, this pavement has done well; in the latter city the tar-cement covering is only 7 centimeters (1.78 inch) thick, but a week after its laying it was run over by a steam roller without showing any signs of ill usage. Here the grade is 1:60. This street shows a smooth, even surface after about 18 months' use. The Bergstrasse, Elberfeld, on part of which the grade is 1:10, has an equally good appearance after 19 months' use.

As regards the strength of the mixture for sewer pipes and the like, tests of a five-weeks-old pipe 15 cm (5.8 inches) clear diameter, 27 mm (1.05 inch) thick, showed that it could carry 130 metric hundredweight (14,300 pounds).

In the matter of impermeability, after subjecting plates 1 to 2 cm (0.394 to 0.788 inch) thick, to water columns in glass pipes 2 to 2½ meters (5.56 to 8.2 feet) long, for six weeks the under sides of the plates were not wet.

The resistance to chemical action has been shown by tests of a 1:4 mixture in a 3 per cent. solution of hydrochloric acid 30 days; 32 per cent. nitric acid, the same time, and sea salt in water, 5, 10, 20, 35 per cent., one year, without change of color or form in the objects immersed.

# PAPERS BEFORE THE AMERICAN WATER WORKS ASSOCIATION.

## TURBINE DRIVEN CENTRIFUGAL PUMPS FOR WATER WORKS SERVICE.

By W. O. Beyer, Pittsburgh, Pa.

IT is only recently that centrifugal pumps have received the serious consideration of water works engineers, altho their economy and efficiency have long since been demonstrated for supplying water in large quantities to industrial plants. It is our purpose here to show that the combined fixed charges and operating costs of the rotatory unit compare favorably with those of the high-duty vertical triple-expansion unit or other type, where the price of coal is not excessive.

The high duty shown by reciprocating engines in water works service, involving the pumping of large quantities of water against a constant head, without any great variation in rate, has long and justly been regarded as a supreme achievement. Due to the direct connection of the pump and engine cylinders and to the high efficiency realized in the unit when the proper attention is paid to its valves and packings, the triple-expansion reciprocating pumping engine has been able to develop duties that are unapproachable by rotatory units consisting of turbines and centrifugal pumps. However, a careful comparison of the total costs of pumping will show that the balance may be entirely reversed when fuel costs do not exceed a certain price per ton. That is, the high first cost of the reciprocating unit, together with the cost of the foundation required, introduce annual charges for interest, upkeep and depreciation, which more than offset the lower duty of the turbine unit.

Of the several types of pumping engines, the following are chiefly used for water works service: The low-duty compound condensing engines, costing, with foundations, piping and appurtenances, about $2,300 per million gallons capacity per 24 hours; low-duty triple-expansion condensing horizontal engines, costing about $2,800 per million gallons capacity; cross-compound condensing horizontal flywheel engines, costing about $3,300 per million gallons capacity, and high-duty triple-expansion vertical condensing engines, costing about $4,800 per million gallons capacity. The figures given are from a paper presented before the American Society of Civil Engineers, May 17, 1911, by the late Charles A. Hague. Since this paper selected the high-duty triple-expansion vertical engine as the only one to be considered in most cases, it is with this type of engine that we shall make our comparison.

The prices for pumping units given below are, to the best of our knowledge, accurate and include condensers, piping and foundations complete.

No account has been taken of the greater volume required in the buildings for reciprocating units, as a unit volume cost must be assumed which would agree with only one architectural design; similarly, no account has been taken of the greater volume required for the larger boiler installation of the turbine units, for the majority of existing plants usually have their building proportions determined, and a saving could not be made in either room without special complications of no account in this discussion. However, the difference in cost of foundations has been taken into account, because this is an addition in existing buildings and can be computed easily.

In a new station the turbine should be credited with any saving in floor space, buildings, etc., which it may effect, as compared with the reciprocating engine, and the rciprocating engine credited with the saving effected in the boiler rooms.

In a comparison of this kind certain assumptions must necessarily be made. We have tried to eliminate as far as possible arbitrary assumptions, and all figures of first cost of apparatus have been taken from, or estimated from, recent bids on the two types of machinery under consideration. The first cost per boiler horsepower we have taken to be $30, complete with piping, chimney, stokers, etc. (The use of a lower figure would favor the turbine-driven pump as compared with the high-duty engine, but we believe, with everything taken into consideration, this will prove to be an average figure.) We have assumed the following annual charges against pumping machinery:

| | |
|---|---|
| Interest | 5% |
| Depreciation | 3% |
| Repairs and supplies | 2% |
| Total | 10% |

We have also assumed the following annual charges against the boiler equipment:

| | |
|---|---|
| Interest | 5% |
| Depreciation | 5% |
| Repairs and supplies | 5% |
| Labor on maintenance | 2% |
| Total | 17% |

It will be noted in the above that an annual depreciation of 3 per cent. has been taken on the first cost of both the

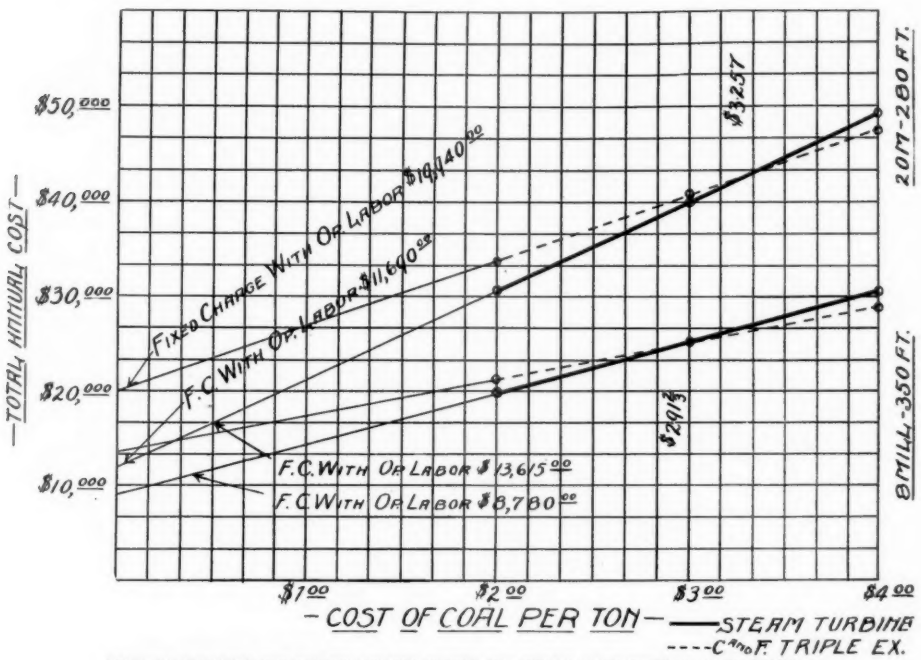
crank and flywheel and turbine-driven unit, equivalent to a life of 33 1/3 years. We have chosen this method rather than one in which the capital charges are figured on a constantly decreasing book value for the pumping machinery and boilers, in order to avoid a complicated method of accounting.

For the reason that less data are available on the life of turbine-driven units than on crank and flywheel units, it is possible more objection may be made to this assumption of a life of 33 1/3 years for each machine. However, as in neither case the question of obsolescence has been taken into account, we believe the assumption a fair one. Viewed in the light of possible future development, it would seem that a longer life should be accorded to the turbine-driven unit than to the crank and flywheel unit, as a very thorough canvass of the whole field of pumping equipment does not bring to light any mechanical apparatus which is being developed to compete with the turbine-driven machinery to the same extent as the turbine-driven machinery is being developed to compete with the crank and flywheel machinery.

It further appears that the steam turbine has reached a stage of development, such that improvements will appear only as refinements of type; and steam economies can only possibly be reduced sufficiently to render obsolete the present good designs by better theoretical design and by better steam conditions. The use of high steam pressures and superheat may be expected to gradually obtain further favor in this country as in European practice, where 250 degrees F. superheat and 200 pounds steam pressure are not unusual. This, however, entails practically no change in turbines as constructed for present steam conditions.

Fuel costs are based on a boiler efficiency of 65 per cent., heat content of 13,000 B.t.u. per pound of coal and 24-hour per day operation.

The duties given are on a basis of 150 pounds steam pressure, with no superheat.




COMPARISONS OF OPERATION COST OF STEAM TURBINE AND TRIPLE EXPANSION ENGINES, SMALL PLANTS.

Three examples are taken, based on coal at $2, $3 and $4 per ton. Where coal can be obtained cheaper than $2 per ton, the advantages of the turbine-driven pump are more clearly marked.

It will be noted that the point at which the total annual costs are equal for the eight-million-gallon crank and flywheel vertical unit and the eight-million-gallon turbine centrifugal unit is when coal costs $2.91 per ton. Also for the twenty-million-gallon vertical crank and flywheel unit and the twenty-million-gallon turbine centrifugal unit, the total annual costs will be equal when coal costs $3.25 per ton. Above these points the reciprocating unit has the advantage, and below these

points the rotatory unit has the advantage, on the basis of these calculations.

TABULATION "A."

8,000,000 gallons per day, 350 ft. head, 491 w.h.p.

| Item | Vertical C. & F. W. Triple Expansion, 150,000,000 Duty, 3 125 h.p. Boilers. | Steam Turbine Centrifugal, 105,000,000 Duty, 3 175 h.p. Boilers. |
|---|---|---|
| Cost pump. unit..... | $72,000 | $16,000 |
| Int. dep., etc., 10%..... | 7,200 | 1,600 |
| Cost boilers..... | 11,250 | 15,750 |
| Int. dep., etc., 17%..... | 1,915 | 2,680 |
| Labor, 3 shifts— | | |
| Engines ..... | 2,700 | 2,700 |
| Boilers ..... | 1,800 | 1,800 |
| Tot. int. dep., etc., and labor ..... | 13,615 | 8,780 |
| Fuel cost, $2 per ton..... | 7,467 | 10,700 |
| Fuel cost, $3 per ton..... | 11,129 | 16,100 |
| Fuel cost, $4 per ton..... | 14,934 | 21,400 |
| Tot. annual cost, $2 coal.. | 21,082 | 19,480 |
| Tot. annual cost, $3 coal.. | 24,744 | 24,880 |
| Tot. annual cost, $4 coal.. | 28,549 | 30,180 |

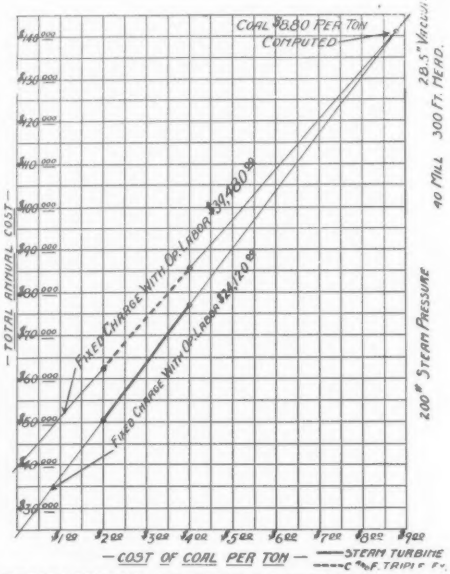
TABULATION "B."

20,000,000 gallons per day, 280 ft. head, 981 w.h.p.

| Item | Vertical C & F. W. Triple Expansion 165,000,000 Duty, 3 225 h.p. Boilers. | Steam Turbine Centrifugal, 120,000,000 Duty, 3 300 h.p. Boilers. |
|---|---|---|
| Cost pump. unit..... | $120,000 | $26,000 |
| Int. dep., etc., 10%..... | 12,000 | 2,600 |
| Cost boilers..... | 20,250 | 27,000 |
| Int. dep., etc., 17%..... | 3,700 | 4,590 |
| Labor, 3 shifts— | | |
| Engines ..... | 2,700 | 2,700 |
| Boilers ..... | 1,800 | 1,800 |
| Tot. int. dep., etc., and labor ..... | 19,940 | 11,690 |
| Fuel cost, $2 coal..... | 13,570 | 18,630 |
| Fuel cost, $3 coal..... | 20,335 | 27,945 |
| Fuel cost, $4 coal..... | 27,140 | 37,260 |
| Tot. annual cost, $2 coal. | 33,510 | 30,320 |
| Tot. annual cost, $3 coal. | 40,275 | 39,635 |
| Tot. annual cost, $4 coal. | 47,080 | 48,950 |

We believe it can be assumed safely that the development of pumping machinery in the future will be along somewhat the same lines as the development of power-producing machinery. At the present time one of the most noticeable features in the development of power machinery is the increasing favor with which larger units are being adopted. In large central station work five years ago, the ordinary size of unit was from 10,000 to 15,000 k.w. Now, not only in European practice, but also in American practice, 25,000 k.w. units are being installed in the large stations. There are two reasons for this development, the first being the continual endeavor to obtain better economy, not only in actual steam consumption, but in capital charges, including first cost, buildings, real estate, etc. The second reason for the development along this line comes from the fact that engineers of today seem to have more initiative than formerly, and where before the development of a 15,000 k.w. turbine would have seemed an impossible task, now the installation of 25,000 k.w. turbines is becoming a matter of course.

We have assumed that there will be progress along this line in water works pumping machinery, and that installations of very large units will be made in




COMPARISONS OF COST OF STEAM TURBINE AND TRIPLE EXPANSION ENGINES, LARGE PLANTS.

the future. We have evolved a comparison between two units of the types under consideration, each having a capacity of 40,000,000 gallons per 24 hours, against a total head of 300 feet. This comparison is based on utilizing the greatest range of steam temperature which the best modern practice has established as commercially practicable, and which at the same time is not too intensely theoretical. We refer here to European practice, in which steam pressures of 200 pounds, 275 degrees superheat and 28.5 inches vacuum are successfully and commercially utilized. Especially important in this connection is the

item of high vacuum, since in the case of water works large quantities of water are always available for condensing purposes.

Extremely large capacities and high heads present no difficulties nor disproportionate costs in the construction of steam turbine-driven centrifugal pumping units, since it is an inherent characteristic of the centrifugal pump that the larger the capacity, the greater the efficiency for a given head.

There is practically no development necessary on the turbine to take advantage of these conditions, as the turbine of almost exactly the same characteristics that would be necessary for this installation is now in successful operation in hundreds of power-producing plants today. We have had to assume no steam consumption, as this is a matter of test, and practically have had to assume no pump efficiencies, as we have taken the minimum which we know can be obtained on this size pump.

Further, the turbine is well adapted to take advantage of the improvement in steam conditions as mentioned above, and reciprocating engines can also be designed as to take advantage of the initial and terminal conditions favoring high economy.

The results of this comparison are shown in table "C." It is apparent from these tables that the point at which the two curves of overall economy of the two units cross is at a cost of approximately $8.80 per ton for coal.

It would appear, therefore, that the field of these large capacities at high heads for ordinary coal costs belongs to the turbine-driven centrifugal pump exclusively.

TABULATION "C."

40,000,000 gallons per day, 300 ft. head, 2120 w.h.p., 200 lbs. steam pressure. 275 deg. F. superheat. 28.5 in. vacuum.

| Item | Vertical C & F. W. Triple Expansion, 223,000,000 Duty, 3 350 h.p. Boilers. | Steam Turbine Centrifugal, 193,000,000 Duty, 3 400 h.p. Boilers. |
|---|---|---|
| Cost pump | $210,000 | $55,000 |
| Int. dep., etc., 10% | 21,000 | 5,500 |
| Cost boilers | 31,500 | 36,000 |
| Int. dep., etc., 17% | 5,360 | 6,100 |
| Labor, 3 shifts— | | |
| Engines | 7,200 | 7,200 |
| Boilers | 5,320 | 5,320 |
| Tot. Int. dep., etc., and labor | 39,480 | 24,120 |
| Fuel cost, $2 coal | 23,265 | 26,800 |
| Fuel cost, $3 coal | 34,897 | 40,200 |
| Fuel cost, $4 coal | 46,330 | 53,600 |
| Tot. annual cost, $2 coal. | 62,475 | 50,920 |
| Tot. annual cost, $3 coal. | 74,377 | 64,320 |
| Tot. annual cost, $4 coal. | 85,810 | 77,720 |

In conclusion, if the above data are correct—and it has been our sincere endeavor to present only such figures as are fair for both types of machines—it would seem that the steam turbine centrifugal pumping unit must be conceded a place of primary importance in the field of water works engineering.

## ICE TROUBLES AT BUFFALO, N. Y.

**By Henry L. Lyon, Deputy Water Commissioner.**

THE city of Buffalo takes its water supply from Niagara River and Lake Erie and pumps it direct into the city mains. The source of supply is unlimited, it is only a question of being able to get it to the consumers on time. The reservoir holds 116,000,000 gallons, but has not sufficient elevation to supply more than half the city, and would not supply that part satisfactorily for more than a few hours. The daily average consumption of the city is 135,000,000 gallons and at times it runs up to 200,000,000 gallons. The reservoir on the low service and the water tower on the high service act more as balance wheels in regulating the pressure.

The old intake pier is situated about the middle of Niagara river and one thousand feet from the pumping station, which is situated on the bank of the river. The intake is built in the narrowest part of the river, about one mile from the head of the river and the foot of Lake Erie. The current is from seven to fifteen miles per hour. The pier is connected to the suction canals, or wells, in the station by two tunnels under the river. One is 6 feet deep, the bottom being smooth lime-cross section. The ports, to admit the water, are about four feet above the bottom of the river and on both sides of the pier. The river at this point is sixteen feet deep, the bottom being smooth limestone rock, with scattered boulders. On the sides of the pier are ice shields of steel extending to two feet above the bottom of the river, so that the water must come under the shields and give us the water from the bottom of the river, not

the surface; but on the sides of the shields are gates that can be opened and closed, so we can take the surface water if ice troubles close the lower levels.

When ice is running down the river, the current turns it over and over and churns it up, forcing large quantities to the lower levels, so the river is a floating mass of ice its whole depth. When the lake becomes frozen over, a certain phase of our ice trouble is over for the winter, and does not bother us again until the break up in the spring.

The location of the pier, however, with a swift running river for a mile above us, so it cannot freeze over, makes an ideal situation for frazil, anchor or ground and slush ice.

Water will freeze and turn to ice if its temperature falls below 32 degrees, even a fraction of a degree. The swift current prevents a surface ice forming. The frozen ice surface in the lake protects the water underneath, as the cold will penetrate water better than ice. When the water flows from under the lake ice, the colder air will cause frazil and anchor ice to form. A heavy snow storm will not melt readily when it falls into the cold water, but becomes water-logged and forms slush.

When we speak of surface ice, anchor ice, ground ice, frazil ice, pebble ice, slush ice, or any other kind of ice, there seem to be no fixed names to separate them, and in a great many cases it is impossible to tell them apart after they have changed their original position or formation and become broken up or mixed. They then become simply slush ice. I will try, in describing them, to take the names that seem to be the more general names given to them.

Surface ice is the form we generally see on the surface of lakes and ponds when their surface is frozen over. It forms first on the surface. As the cold air penetrates the ice and reduces the water directly under the surface ice to a lower degree, it turns into ice, attaches to the upper ice and thus increases the thickness of the ice.

Anchor or ground ice will only form in a running stream on a clear, cold night, the air temperature being very near or below zero. It never forms under surface ice or in cloudy weather. It forms near the bottom of the river and attaches itself to rocks or other hard substances, preferably a dark substance. It loosens itself from the substance to which it is attached when the sun rises or the weather moderates. It is very buoyant, and if stones or other things are imbedded in it will raise them and float them down the stream. It has been known to raise and float abandoned anchors so they could be recovered by the owner or pirates. Small boats should look out for such conditions, because at times it raises in large masses and has been known to overturn such boats.

Frazil ice is only formed in swift running streams, where surface ice cannot form, and then only in very cold weather. It forms best on a dark, windy day or a clear, cold, windy night when the wind is blowing against the current. It is fine crystals, sometimes very hard, and floats readily. When it, as well as anchor ice, is forced under surface ice and attaches to it and to its own particles, it will often fill up the whole bed of the stream and cause floods.

The anchor ice will form on the ports of our intake pier, so as to completely close them. The small particles will seem to rise out of the water like bubbles out of champagne and attach to the sides of the openings, then to each other in lightning rapidity, until the whole opening is closed and cannot be broken by pike poles. We then resort to small charges of dynamite.

Runs of ice of all the varieties, sometimes separately, more often all of them mixed into slush, get into our intake, pass down thru the shafts and tunnels and then into our suction canals, or wells, in such quantities that it clogs the pumps. At times the mixture is so solid that water will not pass thru it to the pumps, and the pumps must be stopped entirely. If the ice is formed at a very low temperature, it is very hard and difficult to melt.

We have revolving screens in the canals with which we can raise large bodies of the ice above the water and then melt it with hot water and steam. We also at times will have a hundred or more men dipping the mixture on to shelves or racks in the wells, above the water, with long-handled scoops, like minnow nets, but made of heavy wire, and then melting it with hot water and steam.

Niagara river, for its full length (35 to 40 miles), is too swift for surface ice to form, so that anchor and frazil ice form readily. It is this ice mostly that runs over Niagara Falls in such quantities that it banks up below the falls and forms the ice bridge every winter, which becomes so solid that people walk over the river just a short distance from and in plain view of the falls. It was this same kind of ice that dammed up the mouth of the river and caused the big floods there a few years ago. And the same kind of ice that has caused the floods at Montreal in the middle of winter when there had been no rains or any warm weather to melt the snow, but the floating anchor and frazil ice had been carried under the surface ice in such quantities as to completely fill the bed of the St. Lawrence, and thus formed a dam over

which the whole of the Great Lakes must flow.

Our new intake pier is built at the head of the river and foot of Lake Erie in water 24 feet in depth. The current at this point is only about two miles per hour. The lake freezes over up to and around the pier. We believe we are in a location where anchor and frazil ice cannot form, the surface ice will only form 15 inches in thickness and our ice troubles are probably a thing of the past.

## HYPOCHLORITE STERILIZATION AT KANSAS CITY, MO.

**By S. Y. High, Chief Superintendent of Water Works.**

THE water supply of Kansas City, Mo., is taken from the Missouri river about five miles above Kansas City, at the Quindaro station in Kansas. The water is pumped directly from the river into settling basins. The water is then treated with lime and sulphate of alumina. After leaving the basins thru the back flow or suction pipe, the hypochlorite solution is introduced before the water gets to the pump, the pump agitation making a thorough mixture of the hypochlorite with the water.

From the Quindaro station the water is pumped to the Turkey Creek station twelve-million-gallon reservoir, and from this reservoir to the service mains.

Since the demonstration at Boonton, N. J., in 1909, of the reduction of bacteria by the introduction of minute quantities of "available chlorine" with water more or less polluted, and the acceptance of the process by the courts as a proper method to be employed in connection with a municipal water supply, the question of the efficient introduction of hypochlorite of lime solution and the mechanical appliances suitable for the purpose engaged the attention of the fire and water commissioners of this city. They ordered the city chemist, Dr. W. M. Cross, to make a trip of inspection of several cities known to have the hypochlorite sterilization system in satisfactory operation.

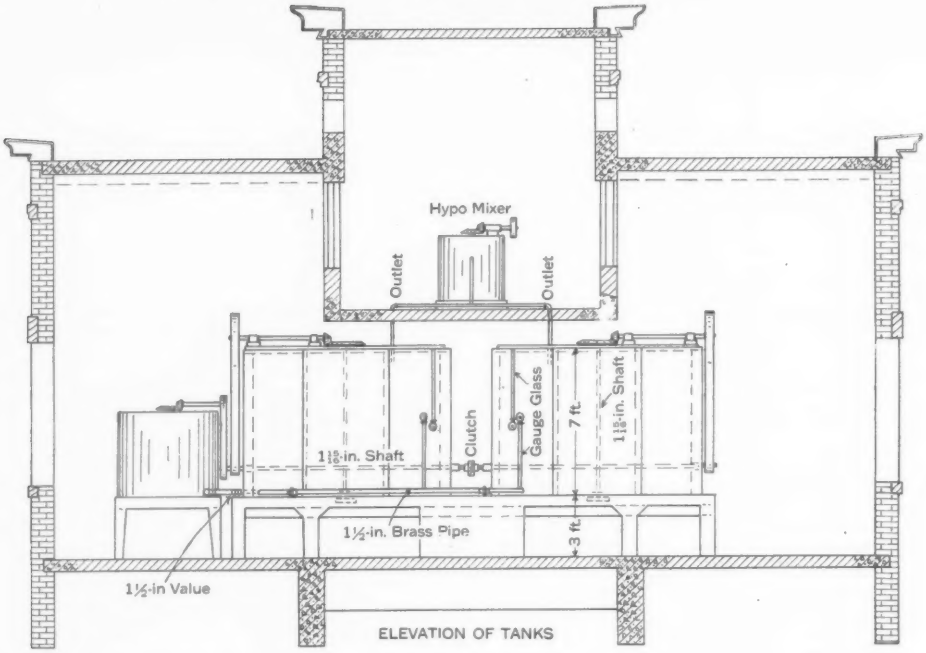
Dr. Cross found the method of installation of the system easy, cheap and satisfactory. During the year 1911 an experimental installation of the hypochlorite process for the approximate sterilization of the entire municipal water supply of Kansas City was so successful that the Kansas City fire and water commissioners undertook the construction of a permanent building and apparatus for the application of this purification process to the entire water supply.

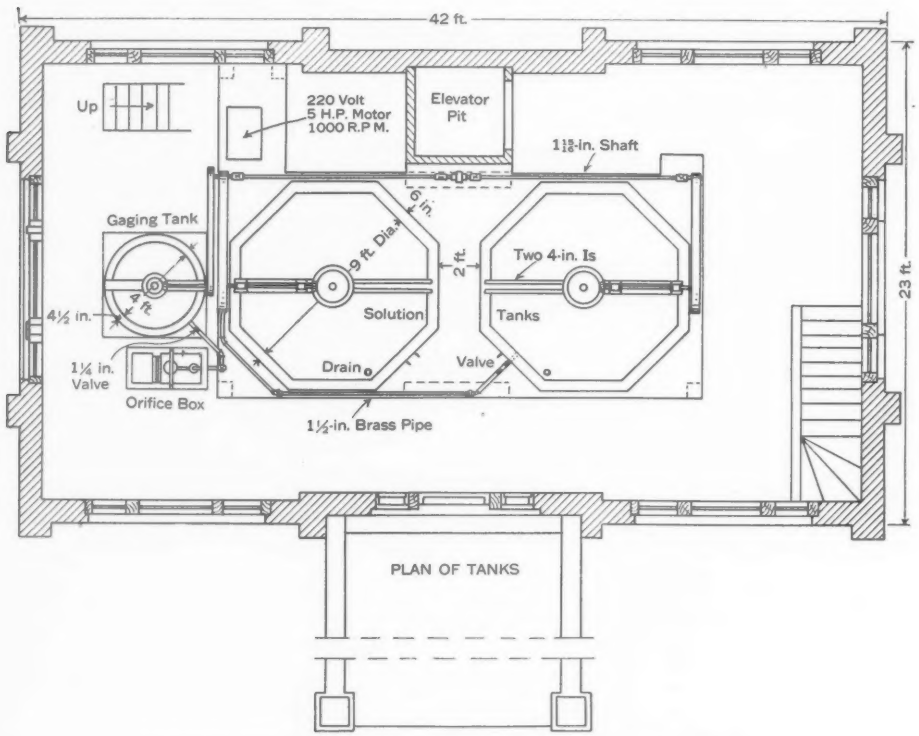
A separate building was constructed to make possible the satisfactory storage, handling and making of the solution of hypochlorite ready for mixing with the sedimented water. The building itself was designed by W. C. Root, an architect, and the apparatus for use in connection with the sterilization process was installed under the direction and supervision of Burton Lowther, engineer in charge.

The apparatus for the handling of the hypochlorite and the supports for it are of reinforced concrete. It is to be observed that no other material is so well suited for use in connection with this sterilizing agent as good concrete, for the reason that all other materials that are capable of oxidation are promptly attacked by the hypochlorite solution and become rapidly deteriorated. The prime consideration with regard to this class of installation is to employ methods of construction and to use material that is so permanent in character as to obviate the necessity of repairs which would force the discontinuance of the application of the sterilizing agent, even for an hour.

The basement of the building is used for storage of the reagent that is kept in reserve. The main floor is used to house the dilution tanks and the feeding devices, while on the floor above is placed the tank, in which the hypochlorite is reduced to paste of a creamy consistency before being delivered to the dilution tanks beneath. This pasting tank, three feet in diameter and four feet high, is provided with a stirring device carrying two rather heavy rollers disposed horizontally at its lower end.

The rollers clear the bottom of the concrete tank only by a fraction of an inch, thus insuring the mashing and disintegration of all of the small lumps that are invariably present in commercial calcium hypochlorite. Owing to the fact that the action of the reagent on bronze is to form on the surface of it a fairly insoluble and protective coating of metallic carbonate and oxychloride, that metal appears to be the most available for use on all bearings and stirring or disintegrating devices that come in contact with the solution. Leading from the concrete pasting tank are pipes so arranged that the contents of the tank may be discharged into either of the large dilution tanks on the floor beneath. The outlet of the pasting tank is placed at a considerable distance from its bottom, so as to avoid the possibility of drawing off with the paste any fragments of considerable size. The pipes




HYPOCHLORITE STERILIZATION PLANT AT KANSAS CITY, MO.

carrying the paste are so arranged as to be readily cleaned in a few minutes in the event that they become clogged. Ultimately, they are sure to become clogged if they are not occasionally cleared, because of the formation in them of carbonate from carbon dioxide absorbed from the air.

The dilution tanks are hexagonal in form, nine feet in maximum diameter and seven feet high. Their walls are six inches thick. Altho the difficulty experienced in properly disposing the reinforcing iron in the construction of a hexagonal tank is much greater than is the case in the building of a round one, the hexagonal tank is to be preferred on account of the fact that in a round tank a rotary stirrer does not produce nearly such thoro agitation and mixing of the solution of hypochlorite as the same stirrer can do in the hexagonal tank. The paste is mixed with water in the dilution tanks until a uniform solution of a strength of 2 per cent. occurs. The use of two tanks makes it possible to accurately adjust the strength of the solution in one solution tank while the contents of the other are being utilized. The dilution tanks are placed on supports high enough to permit the use of a gravity feed to the orifice box, which is placed on the floor of the room housing the big tanks.

Bronze pipes, 1½ inches in size, so arranged as to be readily cleaned in the event of stoppage, connect the dilution tanks with a gaging tank four feet in diameter. This gaging tank contains a float, scale and pointer so arranged that the man in charge can accurately check the speed of outflow of solution from his orifice box into the big water main carrying the entire city water supply from the settling basins to the pumps. The solution passes thru the gaging tank to the orifice box. Each division on the gage represents one gallon of the hypochlorite solution.

The orifice box is oblong in shape and carries a float of about 250 cubic inches displacement. The float operates a valve which, by either opening slightly or closing, maintains the hypochlorite solution in the orifice box to a constant level. One end of the orifice box is of plate glass to enable the operator to see at a glance that the solution is filling the box to the proper height. Attached to the plate glass and covering a hole in it is a hard rubber disc having near its periphery several slits, the adjustment of which fixes the size of stream of the 2 per cent. hypochlorite solution that will be the proper amount to treat the quantity of water passing thru the main. All movements of the hypochlorite solution after its preparation are by gravity. Ample opportunity for the hypochlorite, after its addition to the water, to react with any putrescible organic matter and germs is afforded during the time in which the water passes thru the centrifugal pump, the flow line and a small storage basin at Turkey Creek before it is pumped to the domestic water users.

All stirring devices are run by an electric motor belted to a line shaft carrying clutches so placed as to make possible the running of any one of the stirrers, whether or not any of the others are running.

The principle involved in the construction of practically all hypochlorite installations for the purification of water by the oxidation of germs and putrescible organic matter in municipal water supplies is substantitlly the same as that in Kansas City. Concrete, usually reinforced, is, so far as I know, universally used in the construction of all permanent apparatus for the preparation and solution of the hypochlorite for mixing with the water to be purified.

We find that .30 to .50 parts per million available chlorine is necessary to sterilize, or about one-half part per million, or from 8 to 12½ pounds hypochlorite per million gallons. This amount removes, under ordinary conditions, all B. coli and 99 per cent. of all germs. The cost is about 30 cents per million gallons for labor and material, not including interest and depreciation on plant. As the plant is not yet completed, we are unable to arrive at this additional cost. This additional cost will be small. The 30 cents cost for sterilization is based on a thirty-million-gallon consumption. When the consumption increases, the cost is less than 30 cents per million gallons, so that it probably will not exceed that amount, including interest and depreciation, as the pumpage during the hot and cold months averages over forty million gallons.

In view of the fact that a great many cases of typhoid fever are imported and that there are still open and being constantly used numerous springs, wells and cisterns, known to be contaminated with sewage, the result has been all that could have been anticipated. During the year 1910 no specific attempt was made to destroy pathogenic germs in the municipal water supply. During the year 1911 the hypochlorite process was used thruout the year.

The following tabulation, showing the number of deaths from typhoid fever, month by month, during those years, is illuminating:

DEATHS.

| Month. | 1910. | 1911. |
|---|---|---|
| January | 17 | 6 |
| February | 2[illegible] | 6 |
| March | 10 | 4 |
| April | 8 | 3 |

| | | |
|---|---|---|
| May | 3 | 4 |
| June | 7 | 1 |
| July | 9 | 5 |
| August | 8 | 6 |
| September | 6 | 3 |
| October | 6 | 8 |
| November | 4 | 6 |
| December | 8 | 9 |
| Totals | 107 | 61 |

Now, with this great source of danger from infection by the municipal water supply removed, it is possible for the health commissioner to so enforce the abandonment of questionable sources of water supply and regulate sanitary conditions as to make the occurrence of typhoid fever and most intestinal diseases an uncommon thing in Kansas City.

The following are some germ counts on the city water supply, showing the improvement of the water by the hypochlorite process:

GERMS IN ONE CUBIC CENTIMETER OF WATER.

| Date | Quindaro, Missouri River Before Treatment | Clear Basin Before Treatment | City Hall Hydrant After Treatment | B. Coli After Treatment |
|---|---|---|---|---|
| March 20 | 10,000 | 1,200 | 75 | 0 |
| March 21 | 8,000 | 1,800 | 70 | 0 |
| March 23 | 4,000 | 800 | 100 | 0 |
| March 24 | 10,000 | 500 | 55 | 0 |
| March 25 | 8,000 | 600 | 90 | 0 |
| March 27 | 8,000 | 400 | 25 | 0 |
| March 28 | 5,000 | 260 | 20 | 0 |

The accompanying cut will give a fairly good idea of the disposition of the various parts of the purification installation.

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## THE COST OF LEAKS IN WATER WORKS DISTRIBUTION SYSTEMS.

By Edward S. Cole, C. E., New York City.

OUR nation-wide movement toward the conservation of natural resources has given to water works men a new interest in the curtailment of water waste, especially during the last few years, and it is hoped that these notes may present some phases of an old subject in a new light.

Water works leakage may be classified as follows:

In Pumping Plants—
- (a) Plunger leakage.
- (b) Valve leakage.

Such leaks are known as slippage, causing loss of pump capacity, steam and fuel. Also excessive station use for condensers, etc., should be included.

All water works plants, whether pumping or gravity, suffer loss of product in distribution by:

- (a) Underground leakage from mains and services.
- (b) House fixture leakage—defective plumbing.
- (c) Misuse to save ice in summer or to prevent freezing in winter.
- (d) Steals by large metered consumers.

Almost every water works manager contends with some or all of the above classes of leakage and he must do one of two things, either allow the leaks to continue at whatever cost, or spend time and money in stopping them. Evidently either alternative is expensive and the conscientious official wants to know which will cost him least.

In a pumping plant we should first know the pump leakage. If tests show 15%, as in Chicago, and we assume that well made pumps should operate with a slippage under 5 per cent., then there is a loss of pump capacity, steam and fuel of fully 10 per cent., which, under Chicago conditions, costs $35,000 yearly for coal alone.

Probably the most serious loss involved in pump slippage is that of fire capacity, especially during the hours of maximum draft. The neglect of pump-leakage has in many cities led to the purchase of additional machinery and boilers long before such extensions were really needed. In this way are incurred unnecessary fixed charges which may also be considered as part of the cost of leakage.

As for losses from the distribution system, we now doubt the old saying that, "leaks always show on the surface." Systematic water waste surveys conducted in Chicago, Memphis, Yonkers, Indianapolis, Washington and New York City have brought to light an immense number of underground leaks running continually into nearby sewers, without showing at the surface. In the city of Washington alone, in the past five years, a total of 30,000,000 gallons daily from about 3,000 underground leaks were found, chiefly in mains and service pipes, none of which showed above ground. A new water supply of this amount would have cost $5,000,000, plus extra operating expenses for the new plant, while the stopping of these

leaks actually reduced the operating charges.

By the courtesy of Supt. W. A. McFarland, of the Washington Water Department, I am able to present the following analysis of 2,600 underground leaks, found by him prior to Oct. 28, 1911.

| | | Gals. daily. |
|---|---|---|
| 1,373 | service pipe leaks | 13,669,000 |
| 607 | main joint leaks | 8,076,000 |
| 620 | miscellaneous leaks | 5,520,000 |
| Total 2,600 | leaks | 27,265,000 |

Without giving the entire list of 2,600 underground leaks which I have, the following will serve as examples, including the largest leaks reported by Superintendent McFarland:

| | Gals. |
|---|---|
| G St., bet. 21st and 22d Sts., N. W., def. 4-in. plug | 165,000 |
| 9th St., bet. F and G Sts., N. E., def. 6-in. joint | 140,000 |
| Washington Navy Yard, abandoned 2-in service pipe | 230,000 |
| Capitol Grounds, blow-off valve open | 737,000 |
| C St., bet. 9th and 10th Sts., N. W., broken 6-in. main | 302,000 |
| 9th St., and B St., N. E., (first high service), def. 6-in. joint | 141,000 |
| 21 1st St., N. E., def. 2d abandoned service pipe | 150,000 |
| 5th and T Sts., N. W., 6-in. joint blown out | 132,000 |
| N. H Ave. and Dupont Circle, N. W., 4 def. 6-in. joints | 109,000 |
| Alley bet. 12th and 13th Sts., and R and S Sts., N. W., blow-off on 4-in. main partly open | 150,000 |
| 10th and S Sts., N. W., def. abandoned tap | 135,203 |
| 2d and U Sts., N. W., def. 48-in. joint | 180,000 |

Pressures are reduced thru extra friction loss caused by forcing thru the mains so much more water than reaches the consumers. In a great city where pressures are low this extra friction loss may represent the difference between the first floor and second floor supply in thousands of homes. These families pay the penalty of neglected leaks, and the cost is heavy.

The production cost of water in each particular plant is, of course, the principal basis for estimating the cost of leaks, but there are other elements of value, which I wish to emphasize. The factors determining the cost of water as produced and distributed are too well known to be described here, involving the items of labor, supplies, general expenses and repairs for each of the great divisions:

(a) Purification works.
(b) Pumping station.
(c) Distribution system.

In addition, we should always include overhead charges, interest, sinking fund, depreciation and repairs.

We find a wide variation in the cost per thousand gallons daily, ranging from 3 cents to 10 cents in large plants, while in smaller, less favorably situated, the cost may often run as high as 40 cents, or higher. Hence, it is useless to generalize or even to give the average cost of water in American cities.

We are familiar with the ordinary ordinary items of expense which have been mentioned, but there are other factors which effect the cost of leaks. To take a concrete example:

In the case of Chicago, the Water Survey Engineers have found that the works pump and distribute more than twice as much water as reaches the consumers. It is apparent, therefore, that the elimination of leakage would produce a threefold advantage.

1st. In saving about one-half the fuel.

2d. Increasing pressures by reduced friction loss.

3d. Producing reserve capacity for future growth, thus postponing needed extensions.

To any one familiar with the rate of expenditure for extensions in a great city like Chicago, it is evident that this last item far exceeds all the others in determining the cost of leaks.

Still another basis of value was suggested by the manager of a large private water company last summer, who, during a period of drought, was at his wits end to know how to provide a water supply, not to mention adequate fire protection. At such times of "Peak Load" the real cost of leakage assumes extraordinary proportions.

As for steals, it is comparatively easy to appraise the cost of a leak due to theft on the premises of large metered consumers. Such "leaks" are more common than many suppose and when detected usually result in the payment of meter rates.

Having attempted to show that the cost of maintaining a water supply is largely affected by leakage, it is natural to ask how we may determine the extent of leakage in a given city. I have compiled the list of water consumption figures in Table I from the latest available reports of 166 American cities, arranged in order of per capita consumption.

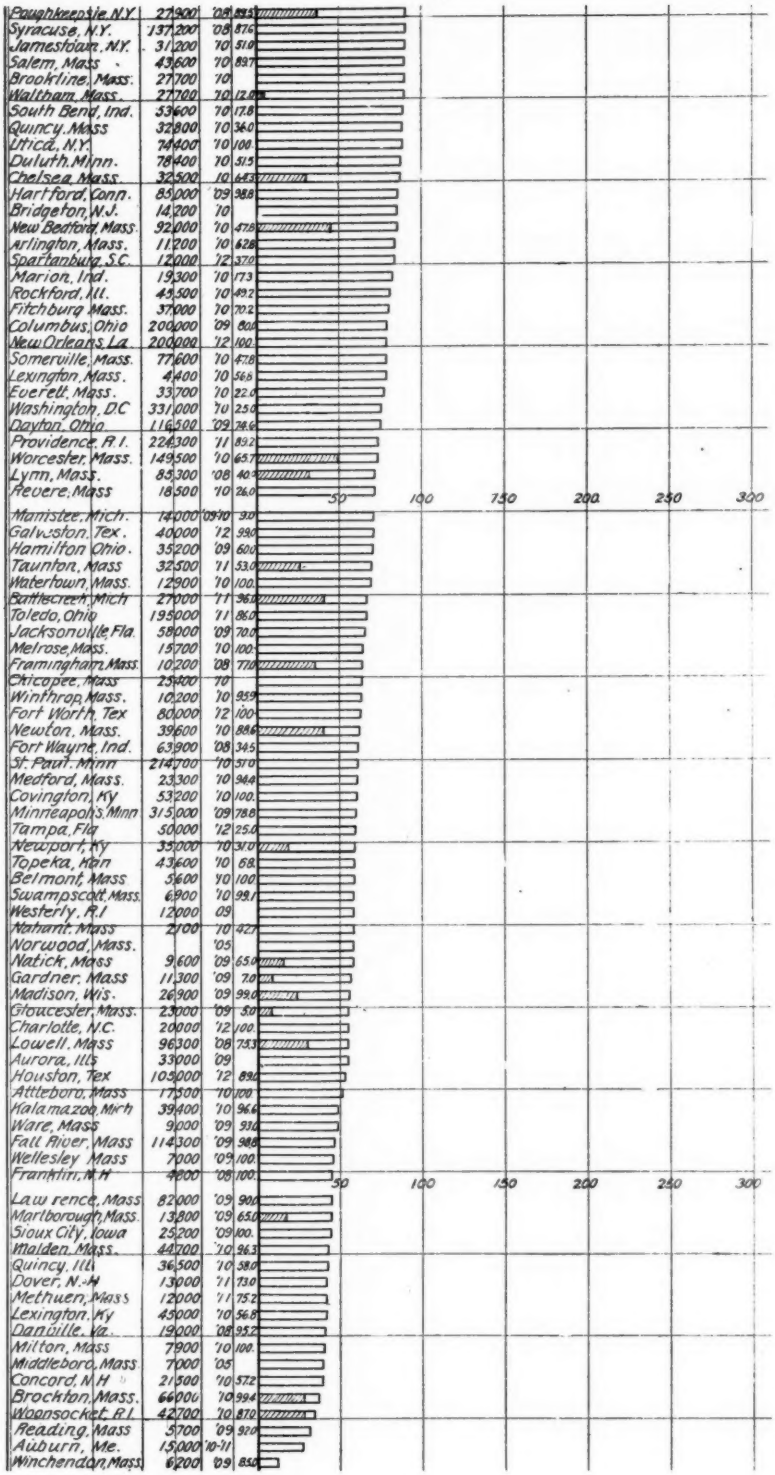
This list illustrates the great variation in total use as commonly reported. It is interesting to compare this table with the water consumption of British cities in Table II, which I have taken from a recently published official directory. We should remember that English cities use few meters, but depend upon the efficient Deacon system of district tests to control leaks.

# WATER CONSUMPTION OF CITIES.

CONSUMPTION : } Metered. Un-Metered.

| CITY | POP. | DATE | PER CT. Taps Metered. | GALLONS PER CAPITA DAILY (0 50 100 150 200 250 300) |
|---|---|---|---|---|
| Buffalo, N.Y. | 423700 | '11 | 4.0 | |
| Salt Lake City. | 57800 | '06 | 2.0 | |
| Waco, Tex. | 25000 | '12 | | |
| St. John, N.B. | 46000 | '08 | 3.2 | |
| Kingston, N.Y. | 25900 | '08 | | |
| Albany, N.Y. | 100200 | '10 | 23.8 | |
| Chicago, Ill. | 2185200 | '11 | 6.0 | |
| Erie, Pa. | 66500 | '10 | 2.5 | |
| Pittsburg, Pa. | 363000 | '06 | 16.0 | |
| Bridgeport, Conn. | 82000 | '06 | 5.0 | |
| Philadelphia, Pa. | 1549000 | '10 | | |
| Port Huron, Mich. | 34700 | '10 | | |
| Springfield, Ill. | 25000 | '09 | 17.8 | |
| Grand Rapids, Mich. | 81000 | '10 | 42.0 | |
| Mobile, Ala. | 63000 | '12 | 100. | |
| Charleston, S.C. | 25000 | '12 | 3.7 | |
| Peabody, Mass. | 12600 | '09 | | |
| Auburn, N.Y. | 34600 | '11 | 5.3 | |
| Lafayette, Ind. | 20,000 | '10 | 9.0 | |
| Camden, N.J. | 80000 | '08 | | |
| Savannah, Ga. | 65000 | '12 | 2.0 | |
| Augusta, Ga. | 45000 | '12 | 5.0 | |
| Jersey City, N.J. | 267700 | '10 | 9.0 | |
| Columbia, S.C. | 27000 | '12 | 100. | |
| Jackson, Miss. | 21600 | '12 | 15.0 | |
| Greensboro, N.C. | 9000 | '12 | 6.0 | |
| Bangor, Me. | 24800 | '07-08 | | |
| New London, Conn. | 19300 | '10 | 15.0 | |
| Pawtucket, R.I. | 50000 | '08 | 83.6 | |
| Lancaster, Pa. | 45000 | '06 | 30.0 | |
| Binghamton, N.Y. | 48400 | '10 | 29.0 | |
| Woburn, Mass. | 15200 | '10 | 2.8 | |
| Atlantic City, N.J. | 37500 | '06 | 78.4 | |
| Montreal, Can. | 321300 | '09 | | |
| San Antonio, Tex. | 100000 | '12 | 16.0 | |
| Boston, Mass. | 674400 | '10 | 20.0 | |
| Cincinnati, Ohio. | 360000 | '10 | 32.8 | |
| Perth Amboy, N.J. | 40000 | '10 | 29.0 | |
| New Brunswick, N.J. | 23300 | '10 | | |
| Meridian, Miss. | 20000 | '12 | 76.0 | |
| Evansville, Ind. | 69600 | '10 | | |
| North Adams, Mass. | 23000 | '09 | | |
| Reading, Pa. | 98500 | '08-9 | 11.9 | |
| Baltimore, Md. | 575000 | '09 | | |
| Schenectady, N.Y. | 72800 | '09 | | |
| Nashville, Tenn. | 100000 | '12 | 74.0 | |
| Springfield, Mass. | 87500 | '10 | 60.8 | |
| Indianapolis, Ind. | 150000 | '09 | 5.5 | |
| Wilmington, Del. | 87500 | '10 | 34.3 | |
| Haverhill, Mass. | 42000 | '10 | 17.1 | |
| Harrisburg, Pa. | 64100 | '11 | 81.0 | |
| Kansas City, Mo. | 250000 | '10-11 | 44.5 | |
| Milwaukee, Wis. | 385000 | '11 | 81.5 | |
| St. Louis, Mo. | 687000 | '10 | 66 | |
| Louisville, Ky. | 207600 | '10 | 8.1 | |
| Met. Water Board. | 1022200 | '10 | 37.6 | |
| Pittsfield, Mass. | 32000 | '10 | | |
| Newark, N.J. | 331000 | '09 | 49.2 | |
| Bayonne, N.J. | 35500 | '10 | 99 | |
| Holyoke, Mass. | 36900 | '10 | 9.0 | |
| Cambridge, Mass. | 100000 | '10 | 38.0 | |
| Knoxville, Tenn. | 60000 | '12 | 42.0 | |
| Plymouth, Mass. | 12100 | '10 | 94.0 | |
| Richmond, Va. | 127600 | '12 | 65.0 | |
| Peoria, Ill. | 75000 | '12 | 36.0 | |
| Cleveland, Ohio. | 516000 | '08 | 93.6 | |
| Macon, Ga. | 50000 | '12 | 26.5 | |
| New York City. | 4910000 | '11 | | |
| Austin, Texas. | 35000 | '12 | 100. | |
| Atlanta, Ga. | 150000 | '12 | 100. | |
| Toronto, Ont. | 360000 | '10 | 4.2 | |
| Yonkers, N.Y. | 77500 | '09 | 100. | |
| Memphis, Tenn. | 135000 | '12 | | |
| Holland, Mich. | 10000 | '10 | 96.6 | |
| Andover, Mass. | 7000 | '07 | 80.0 | |
| Dallas, Tex. | 93000 | '12 | | |
| East Orange, N.J. | 35700 | '10 | 18.1 | |
| Beverly, Mass. | 18600 | '10 | 4.1 | |
| Stoneham, Mass. | 7100 | '10 | 43.3 | |

**TABLE I. (Continued.)**




| | | | | |
|---|---|---|---|---|
| Poughkeepsie, N.Y. | 27,900 | '08 | 85.5 |
| Syracuse, N.Y. | 137,200 | '08 | 87.6 |
| Jamestown, N.Y. | 31,200 | '10 | 51.0 |
| Salem, Mass. | 43,600 | '10 | 89.7 |
| Brookline, Mass. | 27,700 | '10 | |
| Waltham, Mass. | 27,700 | '10 | 12.0 |
| South Bend, Ind. | 53,600 | '10 | 17.8 |
| Quincy, Mass | 32,800 | '10 | 36.0 |
| Utica, N.Y. | 74,400 | '10 | 100. |
| Duluth, Minn. | 78,400 | '10 | 51.5 |
| Chelsea, Mass. | 32,500 | '10 | 44.3 |
| Hartford, Conn. | 85,000 | '09 | 98.8 |
| Bridgeton, N.J. | 14,200 | '10 | |
| New Bedford, Mass. | 92,000 | '10 | 47.8 |
| Arlington, Mass. | 11,200 | '10 | 62.8 |
| Spartanburg, S.C. | 12,000 | '12 | 37.0 |
| Marion, Ind. | 19,300 | '10 | 17.3 |
| Rockford, Ill. | 45,500 | '10 | 49.2 |
| Fitchburg, Mass. | 37,000 | '10 | 70.2 |
| Columbus, Ohio | 200,000 | '09 | 80.0 |
| New Orleans, La. | 200,000 | '12 | 10.2 |
| Somerville, Mass. | 77,600 | '10 | 47.8 |
| Lexington, Mass. | 4,400 | '10 | 56.8 |
| Everett, Mass. | 33,700 | '10 | 22.0 |
| Washington, D.C. | 331,000 | '10 | 25.0 |
| Dayton, Ohio | 116,500 | '09 | 74.6 |
| Providence, R.I. | 224,300 | '11 | 89.2 |
| Worcester, Mass. | 149,500 | '10 | 65.7 |
| Lynn, Mass. | 85,300 | '08 | 40.3 |
| Revere, Mass | 18,500 | '10 | 26.0 |
| Manistee, Mich. | 14,000 | '09-'10 | 9.0 |
| Galveston, Tex. | 40,000 | '12 | 99.0 |
| Hamilton, Ohio | 35,200 | '09 | 60.0 |
| Taunton, Mass | 32,500 | '11 | 53.0 |
| Watertown, Mass. | 12,900 | '10 | 10.0 |
| Battlecreek, Mich | 27,000 | '11 | 36.0 |
| Toledo, Ohio | 195,000 | '11 | 85.0 |
| Jacksonville, Fla. | 58,000 | '09 | 70.0 |
| Melrose, Mass. | 15,700 | '10 | 10.0 |
| Framingham, Mass. | 10,200 | '08 | 77.0 |
| Chicopee, Mass | 25,400 | '10 | |
| Winthrop, Mass. | 10,200 | '10 | 95.9 |
| Fort Worth, Tex | 80,000 | '12 | 10.0 |
| Newton, Mass. | 39,600 | '10 | 88.6 |
| Fort Wayne, Ind. | 63,900 | '08 | 34.5 |
| St. Paul, Minn | 214,700 | '10 | 57.0 |
| Medford, Mass. | 23,300 | '10 | 94.4 |
| Covington, Ky | 53,200 | '10 | 10.0 |
| Minneapolis, Minn | 315,000 | '09 | 78.8 |
| Tampa, Fla | 50,000 | '12 | 25.0 |
| Newport, Ky | 35,000 | '10 | 31.0 |
| Topeka, Kan | 43,600 | '10 | 6.8 |
| Belmont, Mass | 5,600 | '10 | 10.0 |
| Swampscott, Mass. | 6,900 | '10 | 99.1 |
| Westerly, R.I | 12,000 | '09 | |
| Nahant, Mass | 2,100 | '10 | 42.7 |
| Norwood, Mass. | | '05 | |
| Natick, Mass | 9,600 | '09 | 65.0 |
| Gardner, Mass | 11,300 | '09 | 7.0 |
| Madison, Wis. | 26,900 | '09 | 99.0 |
| Gloucester, Mass. | 23,000 | '09 | 5.0 |
| Charlotte, N.C. | 20,000 | '12 | 10.0 |
| Lowell, Mass | 96,300 | '08 | 75.3 |
| Aurora, Ills | 33,000 | '09 | |
| Houston, Tex | 105,000 | '12 | 89.0 |
| Attleboro, Mass | 17,500 | '10 | 10.0 |
| Kalamazoo, Mich | 39,400 | '10 | 96.6 |
| Ware, Mass | 9,000 | '09 | 93.0 |
| Fall River, Mass | 114,300 | '09 | 98.8 |
| Wellesley, Mass | 7,000 | '09 | 10.0 |
| Franklin, N.H | 4,000 | '08 | 10.0 |
| Lawrence, Mass | 82,000 | '09 | 90.0 |
| Marlborough, Mass. | 13,800 | '09 | 65.0 |
| Sioux City, Iowa | 25,200 | '09 | 10.0 |
| Malden, Mass. | 44,700 | '10 | 96.3 |
| Quincy, Ill. | 36,500 | '10 | 38.0 |
| Dover, N.H | 13,000 | '11 | 73.0 |
| Methuen, Mass. | 12,000 | '11 | 75.2 |
| Lexington, Ky | 45,000 | '10 | 56.8 |
| Danville, Va. | 19,000 | '08 | 95.2 |
| Milton, Mass | 7,900 | '10 | 10.0 |
| Middleboro, Mass. | 7,000 | '05 | |
| Concord, N.H | 21,500 | '10 | 57.2 |
| Brockton, Mass. | 66,000 | '10 | 99.4 |
| Woonsocket, R.I | 42,700 | '10 | 87.0 |
| Reading, Mass | 5,700 | '09 | 92.0 |
| Auburn, Me. | 15,000 | '10-'11 | |
| Winchendon, Mass. | 6,200 | '09 | 85.0 |

It is reasonable that we should ask ourselves why there is this great variation among our American cities and between American and English cities in the use of water. The per capita consumption in this country is almost invariably reported as the total use. We lump together indiscriminately, public use, business use and domestic use, which is obviously unfair if comparisons are to be made. In England, on the contrary, the water consumption is usually reported for domestic use as distinct from other uses.

It is evident that the water used for trade purposes in all British cities is small compared with the few available records of manufacturing use in American cities, but I believe that domestic consumption in English cities is not so much lower than it is in many of our own metered cities, if, only we will separate domestic consumption from all other use.

A movement should be started in this country to provide the much needed segregation of use in our water works reports and it is to the interest of all water works men that these data should be forthcoming as rapidly as possible. Our water works literature is rich in meter statistics and these tend to show that domestic consumption in this country need not exceed an actual use of about 30 to 60 gallons per capita daily. Indeed meter readings prove conclusively that the poorer sections of our American cities are using as little as 10 to 15 gallons per capita. We must recognize that there are a few lavish users among the wealthy class in any city, having extensive grounds on which the sprinkler is in continuous operation and having an elaborate supply of house fixtures, but it must be remembered that this extravagant class is exceedingly limited in number and probably has little effect upon the average use of our large cities. Of course we must expect to find greater economy in the older countries of Europe which long ago felt the pinch of a diminishing water supply such as we are likely to suffer in our turn when population has become as dense.

Do not let us deceive ourselves by the use of unfair statistics. It is absolutely necessary to know how we compare in domestic use after deducting water for all other purposes. I would make a most earnest plea that water works men report even approximately, such figures as will help us separate domestic from business use of water. These data would be valuable to every water works man, giving him for the first time the means of demonstrating efficient management and for pointing the way to increased economy thru intelligent comparison.

According to such figures as we have, there are 20 American cities showing a

TABLE II.

WATER CONSUMPTION OF THE LARGER BRITISH CITIES.

| City | Population. | U. S. gal. per hd. daily. Domestic. | Trade etc. |
|---|---|---|---|
| Aberdeen | 163,681 | 36. | 14.4 |
| Accrington | 92,000 | 19.3 | 6.9 |
| Airdie, Coatbridge | 100,000 | 30. | 15.7 |
| Barrow-in-Furness | 84,500 | 32. | 22.2 |
| Bath | 74,000 | 22.7 | 3.3 |
| Belfast | 390,000 | 29.8 | 15.6 |
| Birkenhead | 115,257 | 29.8 | 11.3 |
| Birmingham | 837,776 | 17.9 | 11.4 |
| Blackburn | 143,000 | 16.9 | 8.9 |
| Bradford, | 288,505 | 27. | 25.8 |
| Brighton | 200,000 | 30. | 8.4 |
| Bristol | 379,923 | 30.4 | .... |
| Burnley | 105,000 | 22.3 | 5.5 |
| Cardiff | 236,000 | 16.9 | 14.5 |
| Carlisle | 56,000 | 25.7 | 11.2 |
| Chester | 54,000 | 38.9 | 8.4 |
| Colne Valley | 106,000 | 25.2 | .... |
| Coventry | 101,000 | 18.7 | 4.3 |
| Croydon | 169,559 | 27.6 | 6.0 |
| Darlington | 55,000 | 25.2 | .... |
| Derby | 130,000 | 19.6 | 10.0 |
| Devonport | 75,000 | 35.3 | 15.7 |
| Doncaster | 54,188 | 28. | 14.0 |
| Edinburgh & Leith | 477,000 | 33.4 | 8.4 |
| Exeter | 63,000 | 26.4 | 9.6 |
| Glasgow | 1,134,454 | 44.5 | 27.6 |
| Great Grimsby | 90,000 | 24. | 8.4 |
| Halifax | 110,000 | 18. | 15.6 |
| Huddersfield | 152,000 | 19.2 | 12. |
| Hull | 246,435 | 36.4 | 12.5 |
| Ipswich | 76,600 | 19.9 | 6.2 |
| Leeds | 490,985 | 23.4 | 1.5 |
| Leicester | 282,905 | 16.0 | 7.4 |
| Lincoln | 60,500 | 22. | 7.0 |
| Liverpool | 958,446 | 22.4 | 13.3 |
| Manchester | 1,200,000 | 24. | 18. |
| Merthyr Tydfil | 90,000 | 31.2 | 15.6 |
| Metropolitan Water Board (London) | 7,079,251 | 37.4 | .... |
| Newcastle-on-Tyne | 585,000 | 19.5 | 16.2 |
| Northampton | 120,000 | 15.2 | 3.7 |
| Oldham and District. | 231,787 | 19.2 | 9.6 |
| Oxford | 60,000 | 28.8 | 4.8 |
| Plymouth | 136,568 | 34.1 | .... |
| Pontypridd | 125,000 | 34.8 | 4.8 |
| Preston | 130,000 | 30.0 | 16.8 |
| Reading | 97,877 | 24.9 | 14.4 |
| Rochdale | 125,000 | 18. | 6.0 |
| Rotherdam | 100,000 | 17.3 | 6.2 |
| St. Helens | 90,000 | 25.2 | 15.6 |
| South Hants District | 97,415 | 24.8 | .... |
| South Staffordshire | 701,505 | 19.7 | 5.4 |
| Staffordshire Potteries | 320,000 | 19.2 | 7.2 |
| Stockport | 170,000 | 21.6 | 6.0 |
| Sunderland and S. Shields | 425,000 | 16.8 | 7.2 |
| Swansea | 120,000 | 42.6 | 12.3 |
| Swindon and District | 56,000 | 13.1 | .... |
| Tees Valley | 260,000 | 20. | 50.4 |
| Wigan | 95,221 | 19.5 | 6.7 |
| Ystrad | 75,000 | 23.4 | 3.4 |

per capita daily use for business purposes of from 3 to 70 gallons, most of them using from 30 to 40 gallons. With this allowance in mind, it is interesting to examine our American list, Table I, and note that many domestic rates comparable with those of the English cities (Table II), would remain, after deducting this amount of business use from the totals reported. Of course any such comparisons must be made with care, for business use may vary from nothing in the residential town to a large part of the entire supply in manufacturing centers.

This discussion of reasonable per capita consumption is presented merely as a basis on which to determine whether or not there are excessive leaks in a given city. Without some such basis, many a city is operating wastefully without knowing the truth.

Metered cities are fortunately placed for such an analysis and it would be an easy matter for them to arrive at this necessary basis for comparison. In the fully metered city it is possible to compare the total pumpage or supply with total registration of all meters. The amount remaining "unaccounted for" is, of course, the most reliable criterion of leakage which it is possible to obtain. Occasionally we find a city with practically every service metered but accounting for only 50 per cent. to 60 per cent. of its total supply. The manager of such a plant should entertain no delusion as to the efficiency of his administration. Either he has underground leakage or there is stealing from his mains—and the one costs as much as the other. The question—does it pay to stop leaks?—answers itself.

In conclusion, I have tried to show:

1. What leakage is.
2. That leakage costs far more than the operating expenses, even with overhead charges added, by reason of friction loss and needless extensions of plant.
3. That there is great confusion in the reported per capita use of water in American cities, due to our failure to separate business and domestic consumption, making comparisons unfair or useless.

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## FLOOR AREA AS A UNIT FOR ESTIMATING WATER CONSUMPTION.

**By William W. Brush.**

IN 1908 the writer was placed in charge of the general design of the delivery system to carry to the five boroughs of Greater New York the 500 million gallons per day, which would eventually be available from the Catskill water sheds, this work being carried on by the board of water supply. Studies in connection with the design of this system required a determination of the existing consumption in each borough, and in sub-divisions of each borough, as well as an estimate of probable future growth in consumption.

It was found that the measurements of flow that had been made were not sufficient in extent to give a fair basis for estimating the present consumption in the various sections of the city, and that a per capita basis for consumption was practically useless for this purpose for the Borough of Manhattan, due to the fact that large areas are wholly devoted to office buildings, manufacturing and other business purposes; and also due to the rapid changes going on in the elimination of buildings previously used for residences and the substitution of office buildings, lofts and factories.

While the water consumption of both large and small communities is generally expressed as the average amount supplied "per capita," this unit is used more on account of its convenience than for its usefulness as a basis for comparison of consumption in different towns and cities. The census, national and state, which is usually taken at intervals of five to ten years, gives data from which the population can be determined with a reasonable degree of accuracy and the per capita consumption readily calculated. It is evident that this unit is not one that gives an accurate standard for comparison, as the conditions as to kind and extent of manufacturing and other industries, character of buildings used for residential purposes, character of population, density of population, etc., affect the amount of water required for a community, exclusive of the amount lost thru waste. In examinations made of the per capita consumption in different sections of large cities, variations of several hundred per cent. have been shown, due to the above causes. The highest consumption is generally found in the highest class apartment houses, and the lowest consumption in the lowest class of tenements.

To carry out the work required to satisfactorily design the Catskill delivery sys-

tem, some unit of consumption was necessary that did not vary to the extent of the per capita unit and that could be applied to business as well as residential sections. An investigation of the available data, on which to estimate future as well as present consumption, showed that the area occupied by buildings would be the fundamental basis for future consumption, especially in the Borough of Manhattan, and that, other things being equal, the amount of water used in any building would be dependent upon the ground area covered and the number of stories in height. It was therefore decided to study the use of the floor area unit as a basis for estimating consumption. The floor area was to be determined by multiplying the ground area of a building by the number of stories, allowing one additional story for basement or cellar. One thousand square feet of floor area was found to be a convenient unit, and one that would give a resultant consumption averaging about three times that figured on a per capita basis. There was no record that the floor area unit had been previously used in other cities, and therefore no data were available for comparison of results obtained by the use of this method in New York City, altho in a few instances the consumption had been determined for the ground area covered by buildings. The consumption per service, consumption per fixture, consumption per unit of length of main and consumption for other units have been computed in special cases.

The main reasons for adopting the floor area basis for New York City are summarized as follows:

First. The amount of water used in any building is proportional to the size and height of same.

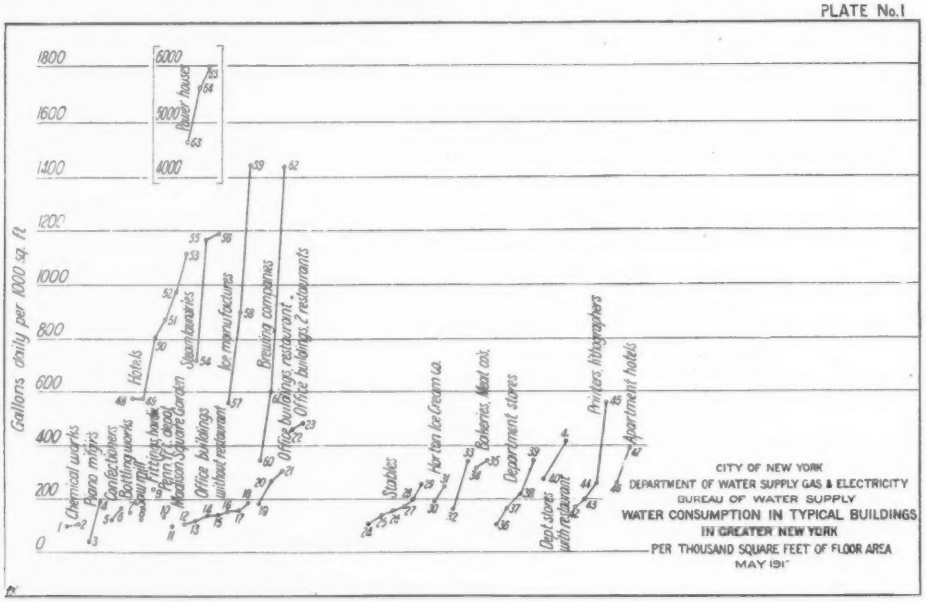
Second. The total floor area could readily be obtained from available atlases.

Third. The very large areas, especially in the Borough of Manhattan, occupied only for business purposes.

Fourth. The large and increasing population, especially in the Borough of Manhattan, which is transient, and therefore cannot be accurately determined for the present nor for the future.

Fifth. The presence of several hundred thousand people in Manhattan, engaged in business, who make their homes in adjoining sections of New York state and New Jersey.

PLATE No.I




I. WATER CONSUMPTION PER 1,000 SQUARE FEET OF FLOOR AREA IN BUILDINGS.

To determine the present use of water per unit of floor area, typical buildings were selected, in which the supply was measured by meters, and the resultant consumption determined. (Plate I.) There were also available measurements of various districts in Manhattan, Brooklyn and the Bronx, which were made by use of the pitometer during waste investigations carried on in 1902-03. The following table gives the results of these measurements, as well as those taken in 1911, a reduction in consumption in 1911 of about 15 per cent. having been effected by house-to-house inspection, while in 1902 no special work had been done on water waste prevention:

GAGINGS—1902-03.

| No. of District | Characteristics of Occupancy | Consumption M. G. D. | Population Resident | Consumption Per Capita |
|---|---|---|---|---|
| 1. | Large hotels, high-class residences | 1.87 | 8,396 | 223 |
| 2. | East Side tenements | 1.44 | 38,906 | 37 |
| 3. | East Side tenements | 5.40 | 90,000 | 60 |
| 6. | Residence and high-class apartments | 0.76 | 10,164 | 75 |
| 8. | Business, office buildings, water front, shipping | 9.45 | 11,000 | 860 |
| 9. | High-class apartments and hotels | 1.37 | 8,872 | 154 |
| 10.* | East Side tenements, some water front | 20.00 | 218,023 | 93 |
| 11. | Uptown residences and medium-class apartments | 4.89 | 4,380 | 112 |
| 12. | Upper East Side tenement, water front, power houses and breweries | 2.75 | 39,969 | 69 |

GAGINGS—1911.

| | | | | |
|---|---|---|---|---|
| 1a. | East Side tenement, some water front (same as District No. 10) | 11.44 | 230,000 | 50 |
| 2a. | All classes | 29.48 | 204,557 | 144 |
| 3a. | High-class apartments and residences | 22.18 | 186,990 | 118 |
| 4a. | High-class apartments, residences and tenements | 12.74 | 138,800 | 92 |
| 5a. | East Side tenement and water front | 8.28 | 84,580 | 98 |
| 6a. | High-class apartments, residences, tenements and water front | 14.82 | 173,000 | 86 |
| 7a. | All classes | 13.38 | 169,100 | 79 |
| 8a. | All classes | 13.66 | 209,393 | 65 |

*An error was later discovered in the measurement of flow in this district, which reduced the consumption as given by about 50 per cent.

The above districts are shown on Plates Nos. 2 and 3 (not reproduced, and the consumption plotted on Plate No. 4. (The districts used in 1911 are much larger than those of 1902-3 and are generally in different locations, except that district 1a of 1911 is the same as district 10 of 1902-3.)

With a variation in the per capita consumption of from 37 gallons to 860 gallons daily, it was evident that it would be difficult to apply a per capita basis to different sections of the city to determine the consumption in such sections.

It was found, upon examination, that, with the exception of those buildings where the consumption of water would be unusually high, such as hotels, laundries, ice plants, etc., the use of water per thousand square feet of floor area was from 150 to 300 gallons per day. This covered only those buildings used for business purposes, as under the rules of the water department, meters are not required in buildings used for residences. It was anticipated that apartments of the higher class would show a somewhat larger use of water per unit of floor area than would the tenement class, and that both would show a larger use than private residences. The first computations made of consumption in districts which covered several blocks included a high-class apartment house and hotel section in the vicinity of Eightieth street, on the West Side, and a low-class tenement section on the East Side in the vicinity of Eightieth street. The per capita consumption in these two districts was 154 gallons per day and 37 gallons per day, respectively, the high-class apartment district therefore showing a consumption, on per capita basis, of over 400 per cent. of that shown for the tenement house district. On the floor area basis the figures for these two districts were 181 and 179 gallons per day per thousand square feet, respectively, or a variation of less than 2 per cent. between the two districts. While this close agreement in consumption for the two districts was a coincidence, it strikingly illustrated the uniformity obtained from the floor area basis as compared with the per capita basis in two residential districts where the character of population varied widely. As further studies showed the floor area basis to be a practical one, it was applied generally to the Borough of Manhattan. The ground area was scaled from the atlas, and this area multiplied by the number of stories, the buildings being grouped as far as possible to reduce the labor. It was found that it required the equivalent of about one man's time for four months to determine the floor area for this borough, the area in each block being estimated separately. After the entire area of the Borough of

Manhattan had been determined, the average consumption was computed and proved to be about 300 gallons per thousand square feet.

To determine the prospective use of water in the Borough of Manhattan, the area available for buildings was determined, eliminating street and park areas, and the borough was divided into four groups, the average height of building and percentage of ground area to be built upon in each group being estimated. The future consumption per thousand square feet of floor area was taken as 350 gallons for that section of the city lying below Fifty-ninth street, to provide an ample margin of safety in the estimates. The following gives the units adopted:

| Section | Average Height of Building. Stories. | Percentage of Block Built Upon. | Consumption per 1,000 sq. ft. of floor area. Gals. daily. |
|---|---|---|---|
| South of 23rd St.... | 8 | 85 | 350 |
| 23rd to 46th St..... | 10 | 85 | 350 |
| 46th to 59th St..... | 8 | 85 | 350 |
| 59th St. to Spuyten Duyvil ..... | 6 | 75 | 300 |

These figures gave an ultimate estimated consumption of 835 m.g.d.

In addition to estimating the ultimate consumption in the Borough of Manhattan, the present and prospective use of water in the various sections of the borough were estimated as a foundation for studies of the size of connections for the new Catskill aqueduct.

The experience of the past three years has shown that the floor area basis is useful also in the following work:

First. To determine what is the reasonable consumption in districts which are being surveyed by use of the pitometer, thus determining whether further investigations to detect leakage are advisable.

Second. To determine consumption in individual blocks, or groups of several blocks, where it is proposed to extend high service to cover districts previously supplied from low service.

Third. To determine whether metered consumption indicated for large buildings is probably correct, where question has arisen as to the presence of illegal connections.

Fourth. To determine size of tap that should be granted for a new building.

The following illustrations of the use of the floor area basis in connection with gagings of flow into districts and the use of water in buildings are of interest:

In measuring the flow of water into District No. 10 in 1902-03, an error was made in the direction of flow thru one of the large mains included in this district. The flow in this main, which was about 5 m.g.d., was taken as being into the district, whereas it should have been out of the district. The resultant error was, therefore, about 10 m.g.d. or about

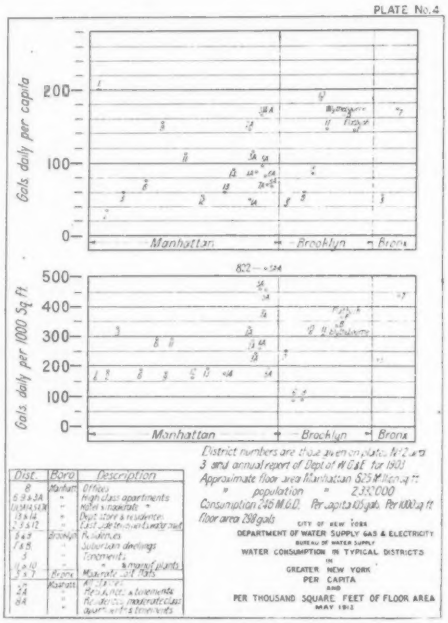


PLATE No. 4
Gals. daily per capita
200
100
0
Manhattan
Brooklyn
Bronx
Gals. daily per 1000 Sq. Ft.
500
400
300
200
100
0
Manhattan
Brooklyn
Bronx
District numbers are those given on plate, N° 2 and 3 and annual report of Dept of W G & E for 1901
Approximate floor area Manhattan 525 Million sq ft
" population " 2,332,000
Consumption 246 M G D. Per capita 105 gals. Per 1000 sq ft floor area 238 gals
CITY OF NEW YORK
DEPARTMENT OF WATER SUPPLY GAS & ELECTRICITY
BUREAU OF WATER SUPPLY
WATER CONSUMPTION IN TYPICAL DISTRICTS
IN
GREATER NEW YORK
PER CAPITA
AND
PER THOUSAND SQUARE FEET OF FLOOR AREA
MAY 1902
Dist. | Boro | Description
8 | Manhattan | Offices
6 9 3A | " | High class apartments
10 14 15 16 | " | Hotels & residential
13 & 14 | " | Dept. store & residence
2 3 12 | " | Loft, office & mixed uses
4 & 5 | Brooklyn | Residences
11 & 18 | " | Suburban dwellings
1 | " | Tenements
17 & 20 | " | Commercial & manufacturing
3 & 7 | Bronx | Mainly 2 & 3 fam. houses
22 | Richmond | Mixed uses
24 | " | Residences, tenements, residences, moderate cost, country & suburban

IV. TYPICAL WATER CONSUMPTION PER 1,000 FEET FLOOR AREA.

equal to the actual flow into the district. The resultant per capita consumption was 83 gallons, and was not considered to be abnormal. When the floor area unit was applied to this district, it was found that the consumption per thousand square feet was over 600 gallons per day, whereas no other district was found where the consumption had equaled 400 gallons, and few had exceeded 300 gallons. Investigation and subsequent measurements of flow in the district clearly showed the error, which was only discovered by applying the floor area unit.

The question of the presence of one or more illegal connections between the city's mains and the piping system of one of the large hotels was brought up. It was found that to measure the flow in the street mains and thus check the meters in the building would necessitate several taps, and the size of the mains was such that the rate of flow would be too small to give a reasonable degree of accuracy in the reading that might be obtained. To make the necessary taps and take readings would have cost several hundred dollars and would have interfered with traffic on two of the most congested streets in the city. A compari-

son of the use of water in this building on the floor area basis with that of several other buildings of like character showed that the building in question used more water than any of the other buildings. The evidence, therefore, was conclusive that the full amount of water supplied was passing thru the meters.

The per capita basis for estimating consumption is the most practical one for general use, and will undoubtedly continue to be the standard unit. Experience with the floor area basis in New York City has shown, however, its usefulness in water works operation, and it is believed that other cities than New York will find occasions where the floor area basis can be utilized to advantage.

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## THE WOOD STAVE FORCE MAIN OF THE ATLANTIC CITY, N. J., WATER WORKS.

**By L. Van Gilder, Chief Engineer and Superintendent.**

IN preparing this paper for your consideration, it has been the writer's aim to make it descriptive rather than technical, believing that you have all given the subject sufficient study to establish to your own satisfaction the practicability of wood stave pipe, if used under reasonable conditions.

It may, perhaps, be interesting to review briefly the history of the Atlantic City water department, in order to show the reasons for building a wood stave main.

In 1882 the original franchise holders, headed by R. D. Wood & Co., erected a pumping station on the main land and laid a 12-inch cast iron main to connect with the city, a distance of approximately 26,000 feet, of which about 2,000 feet were laid in sand; the balance, across salt marsh.

In 1888 a 20-inch cast iron main was laid parallel to the first, to provide for the city's growing demands.

In 1895 the city purchased the property and franchise, together with a small artesian well plant within the city limits, operated by an independent company, and since that time the water department has been owned and operated by the municipality.

In 1901 the city had outgrown the economic capacity of the old mains, and a 30-inch riveted steel main was laid parallel to the other two.

After careful investigation, the board of water commissioners and Supt. W. C. Hawley, now of Wilkinsburg, Pa., had recommended building a continuous type wood stave main, but the city council (then supreme) overruled the recommendation and adopted steel.

Within two years pit holes began to appear in this pipe, and it is now, after eleven years of service, in such condition that extensive repairs must soon be made or it must be abandoned.

In 1906 the first steps were taken toward building a new and larger force main, both as a precautionary measure and to lower the peak load friction head.

The cast iron mains were materially weakened by softening on the outside, and the steel main was rapidly nearing the end of its usefulness; therefore, the department, now wholly under the control of the board of water commissioners, decided to lay a 48-inch wood stave main as being the most economical, easiest to repair, least flow friction and having the least effect on the water carried.

As to the durability of the wood, there could be no question, years of experience with piling, telegraph poles, etc., having shown that every variety of wood embedded in salt marsh was preserved indefinitely.

The bands and saddles were the doubtful parts, but since there was every reason to believe that they would have an average life of from 10 to 12 years and could be replaced if taken in time without putting the main out of commission, it was decided that a wood stave main should be built.

Of the two types of wood pipe in general use, the spiral-wound, factory-made was not considered advantageous for the three following reasons:

First. Because the thin, flat bands present a much greater ratio of surface to net section than round rods, hence more rapid corrosion.

Second. The failure of a band in one place would endanger a whole section.

Third. Because of the difficulty of satisfactory rebanding with the pipe in service.

As general experience with structural wrought iron and steel has shown the former to be much the more durable when exposed to the weather or to salt water, no consideration was given to the latter, altho its adoption would have effected a material saving in contract price.

The saddles were malleable castings weighing about two pounds each, one saddle for each band.

The bands were ⅝-inch round wrought iron of from 45,000 to 52,000 pounds per square inch, ultimate tensile strength, and spaced 2 inches on centers at the intake end for a minimum working pressure of 65 pounds per square inch.

To provide for uniform strength of band thruout, the threaded end was upset for a standard ¾-inch nut, and numerous tensile tests showed no weakness incident to threading.

The bands and saddles were heated and dipped at the mill and foundry in hot asphaltum, dipped again in the same material before assembling and were hand-painted with cold asphaltum paint after coopering and cinching.

The wood selected was Washington fir, altho bids were invited and received on California redwood, long leaf yellow pine and white cedar.

The staves were run from 2x6-inch rough stock and were finished 1⅝ inches thick with straight radial edges, 29 staves to the circle. No two adjacent staves were butted in the same transverse plane, and all butt joints were sealed by inserting ⅛x1½-inch galvanized iron tongues in tight-fitting kerfs sawed in the stave ends. These tongues were somewhat longer than the kerfs, in order that they would be slightly embedded in the edges of the adjoining staves.

Manholes were inserted at intervals of about 1,000 feet, and each manhole was made up of one 48x16-inch flanged tee, one 16-inch blank flange and two 48-inch flange and bell pieces. The staves were entered in the bells and were jointed with jute and lead. With care taken to pour the joints full and solid, no trouble has been experienced with them, altho for extra security the bells were cast 6 inches deep.

All flange joints were made with lead gaskets and bronze bolts, the latter being especially desirable to resist the action of salt water.

The right-of-way chosen involved crossing three navigable streams besides as many drawbridges, and while the War Department permitted us to lay the pipe on trestle work from shore to channel, we were compelled to leave open water the entire length of the draw span and the full depth of the channel, the maximum being about 105 feet wide and 13 feet deep at mean low tide.

These channel crossings were made by ending the wood pipe in a manifold at each side of the draw and laying four 24-inch inverted siphons across the channel, the manifolds and siphons being supported by piling.

Each manifold was made up with one 48x48x48x24-inch cross, three flanges, one bell, three 48x48x24-inch flange tees and two 48-inch blank flanges, all of standard patterns. A valve was bolted to each 24-inch manifold flange, and the siphons were made up of 24-inch flanged pipe and quarter bends.

By this arrangement a leaking siphon can be put out of service and be repaired at pleasure without seriously impairing the efficiency of the main. The only difficult feature of this construction was to provide sufficient resistance to prevent blowing the manifolds off the pipe at the bells. This difficulty was overcome by providing sectional cast iron clamp collars, one behind each bell shoulder and two on the pipe, at short distances apart, the frictional resistance of the two pipe collars when transmitted to the bell by tension rods being sufficient to balance the thrust. As an extra precaution, concrete anchor blocks and tie rods were also provided.

The weight of the pipe as built was about 185 pounds per lineal foot, and the only foundation required was a line of 1x12-inch boards doubled break-joint fashion each side of the trench with light cross-timbers at about 8-foot intervals. This also provided a convenient footway for the workmen thru the soft bottom.

It is interesting to note that the weight of this pipe when full is approximately 970 pounds per lineal foot, whereas the weight of a 48-inch cast iron main, class B, A. W. W. A. specifications, is about 1,565 pounds per foot, filled.

All manhole castings are carried on pile foundations, and, as the piling and caps are below water level, their preservation is assured.

The contract price of the wood stave portion of the main, including trenching not less than 30 inches deep across the marsh, and backfilling, not including extra embankment, was $5.28 per lineal foot. All manhole castings were provided and set for $458.51 each, and the cost of each thoroughfare (navigable channel) crossing, including about 400 feet of creosoted pine trestle work to carry the pipe to the manifolds, was $25,857.25.

Work was begun on this main March 15, 1910. It was put in service July 10, 1911, and has been in constant service since. No trouble has been experienced with the wooden structure, and the leakage has been practically nil.

The thoroughfare crossings have given some trouble, but we believe the weak points have been overcome.

After two years of exposure the bands and saddles do not show serious corrosion; and, while it is too soon to make any reasonable prediction as to their durability, their present condition appears to justify the original assumption that extensive rebanding would not be required under ten years.

# METHODS AND COST OF A LEAKAGE SURVEY FOR LANCASTER, PA., WATER WORKS.

By F. H. Shaw, Engineer and Superintendent.

THE city of Lancaster is located in the southeastern part of Pennsylvania on the main line of the Pennsylvania Railroad, between Philadelphia and Harrisburg. It has a population of about 50,000 and is the business center of a rich agricultural district.

The city has an area of four square miles, about three of which are built up, the houses being constructed of brick with practically solid fronts between streets. This method of construction gives a population of about 25 per acre.

The city is supplied with water by a municipal plant the first construction dating back to 1836. The water is taken from the Conestoga Creek, a tributary of the Susquehanna River, having a drainage area of 310 square miles of highly cultivated farming country containing many small towns and a population of 120 per square mile.

The water is filtered and pumped into the city against a head of 250 feet, the supply being measured by a Venturi meter located between the filter plant and the pumping station.

The distribution system is connected with the pumping station by two force mains, one 30-inch and one 36-inch, each being about one mile in length.

The distribution system is divided into high and low service districts. The low service district contains about 0.4 of a square mile and is supplied from the old reservoir constructed in 1836 and in 1850, which have a capacity of 6,000,000 gallons. These reservoirs are filled at night by pumping through the 36-inch main.

The high service district is supplied thru the 30-inch main by direct pumping. The water passing thru a standpipe having a capacity of 400,000 gallons, located on the reservoir grounds. The distribution system consists of 70 miles of pipe, varying in size from 24 inches to 4 inches. The system has been extended outside the city limits by various water companies, their supply mains being metered at the city line. There are about 10,500 services in use, one-third of which are metered. All large consumers are metered and meters are being installed at the rate of about 400 per year, all new properties being metered. The schedule rate for a three-story house having bath, two closets and pave wash is $17.00. The meter rate is 5 cents per 1,000 gallons with a minimum of $10.00.

The daily consumption averages about 7,000,000 gallons, varying between 5,000,000 and 10,000,000, with a maximum pumping rate as high as 12,000,000 for short periods. Assuming a population of 50,000 this will give a per capita consumption of 140 gallons daily. This excessive consumption led to an investigation of causes and methods for correcting same. A general house to house inspection was made during the winter of 1910, at which time all plumbing was inspected for leakage. Results of this inspection were recorded on a card for each property inspected. As a result of this inspection the yearly income from water rents was increased $3,500.00. The city was then divided into four districts, and a regular inspector appointed for each district. A yearly inspection is made of each house and property owners are compelled to repair all leaky fixtures within 10 days, 480 causes being reported and repaired during the last year.

During these investigations the necessity of a systematic search for leakage from mains become apparent and the discovery by accident of a leak which was costing the city about $10,000 per year, brought the matter to a head and the necessary appropriation was made.

The survey party was organized from employes of the Water Department, a foreman who had been in the department for 20 years being placed in charge of the work. The party worked 9 hours per day, and was composed as follows:

*Organization.—*

| | |
|---|---|
| Foreman, per day | $ 3.00 |
| Single team and working driver | 2.50 |
| Three laborers at $1.80 per day | 5.40 |
| Total cost per day | $10.90 |

*Outfit.—*

One 4-inch meter with 2½-inch connections on truck.

One ⅝-inch meter.

One pressure gage.

Two 25-foot lengths 2½-inch fire hose.

Two hundred and fifty feet 2½-inch galvanized pipe.

One small tool box.

Picks, shovels, wrenches, calking tools, lead, wool, etc.

The first step in preparing this work was an inspection of all valves and repairs to same, placing them in working order and replacing some which could not be operated. This work was done by the men in the distribution department in advance of the survey. The survey was started in March 6, 1911, and stopped for

the winter on December 13th. The method of procedure was as follows:

The 4-inch meter was mounted on a small four-wheeled truck and the connections bushed down to 2½ inches with a 2½-inch valve at inlet and outlet. The large meter was by-passed by a ⅝-inch meter for use on small flows. A pressure gage was attached to the outlet end of the large meter. The districts tested had an average area of 12 acres containing about 80 houses. The district to be tested was shut off from the remainder of the system by closing all valves on street mains. The meter was then connected with a hydrant outside the district by means of a 25-foot length of fire hose. The 2½-inch pipe line was laid from the meter to a hydrant inside the district, being connected with it by another short length of hose.

The consumption of the district was then measured for one hour, readings being taken every ten minutes and any reductions in pressure noted. Any considerable drop in pressure indicates either a large leak or that the district is too large to be supplied through 2½-inch pipe. After the consumption had been measured, all connections were shut off inside the houses, an inspection of house plumbing being made at the same time. A test was then made to determine whether any street valves were leaking water into the district by opening a fire hydrant and watching for any flow from the opening.

After everything was shut off the leakage was measured by the large or small water meter according to the amount. This flow, if any, represented the leakage from mains and also from the services. To locate the leaks, the streets inside the districts were cut out one at a time by closing the valves until the leak had been located by using the telephone on curb stops, hydrants and on drills driven down to the main. After the leak had been definitely located, it was dug up and repaired by the survey party and the district tested until found tight.

The work was carried on for 240 days at a cost of about $11.00 per day, or $2,640.00 for the season of labor. The cost of lead, wool, etc., for repairing leaks was very small. One hundred and eleven districts were tested, having a total area of 1,310 acres, or 12 acres per district. There were approximately 9,000 houses in the territory covered.

Following are the leaks discovered and repaired:

*Residences.—*

| | |
|---|---|
| Closets | 20 |
| Yard hydrants | 10 |
| Faucets | 19 |
| Service mains | 17 |
| | 66 |
| Street valves | 12 |
| Fire hydrants | 35 |
| Street mains | 29 |
| | 76 |
| Total number of leaks | 142 |

The leaks varied from 1 to 19 cu. ft. per minute. The largest leak found was a 3-inch elbow split wide open and running at the rate of 205,200 gallons uer day. This line had been by-passed around the meter outside the building and was supplying four buildings. In this case the survey not only stopped the leak, but detected the illegal use of water. This leak amounted to 75,000,000 gallons per year, the actual cost of furnishing which was $2,812.50, or $172.50 more than the cost of the entire survey.

The total mileage of mains inspected was 40.8, varying in size from 4 inches to 24 inches. The total leakage record was 118 cu. ft. per minute, or 1,271,000 gallons per day. Using $37.50 per million as the actual cost of furnishing water, exclusive of interest, the total leakage was costing the city about $17,000 per year.

About one-quarter of the system remains to be tested, also the 20-inch supply main which runs directly across the city. Work is now in progress on this section. One mile of 36-inch force main was laid in 1888, and tested by closing the valves at both ends, and supplying it from the other force main thru a small meter. Leakage was found amounting to $2,000 per year. The joints on this main will be dug up and recaulked during the present season. The results of the leakage survey were not as apparent as was expected for two reasons—one of which was the exceedingly dry summer and failure to provide for street sprinkling by wagons, causing a great increase in the use of individual hose sprinklers. Another reason was the exceedingly cold weather during the winter which caused an excessive use of water to prevent freezing and also damaged many service mains, all of which have probably not been discovered.

After the present survey has been completed, some of the districts will be retested to ascertain the damage caused during the past winter. A comparison of the consumption before and after the survey shows a decrease of 10,000,000 per month during March and April, and equal consumption from May to September, a decrease of 8,000,000 per month during October and November, a decrease of 24,000,000 during December and an increase of 20,000,000 during January, February and March, while the present consumption is about equal to that before the survey began, while the consumption for 1911 is slightly less than for 1910.

# EDITORIAL COMMENT

## STANDARD FEES OF CONSULTING ENGINEERS.

The schedule of fees adopted by the American Institute of Consulting Engineers, a small body consisting mainly of engineers with offices in New York City, was published in MUNICIPAL ENGINEERING, in vol. xli, p. 311. One prepared by a number of representative St. Louis engineers and endorsed by the Engineers' Club of St. Louis, appeared in vol. xlii, p. 258. In this number will be found the schedule adopted by the Pacific Association of Consulting Engineers with 22 members. The last is modeled to some extent on the first named and there are considerable differences in the three.

It is perhaps natural that the minimum charge per diem should be greatest in New York, which, as the financial center of the country, is the natural location of those who have developed the maximum ability to secure full payment for services rendered. They are apparently quite willing to cut themselves out of the numerous calls for aid upon work which will not warrant payment of $100 a day for consulting service and yet need the temporary assistance of experts who are willing to proportion their charges to the possibilities of the case. The San Francisco minimum charge of $50 a day is open to the same objection in principle, tho it will reach a much larger number of practical cases than the New York schedule. The St. Louis schedule is much more flexible, in that it gives a variable minimum for a brief engagement, two to ten days, of $50 to $100 a day, which is cut in two for the additional days of a more prolonged connection.

The New York and San Francisco schedules provide also for a retainer on general engineering work "where conditions warrant," of $250 to $1,000 and upwards in New York and a "suitable" amount in San Francisco. The double fee of the first few days of the engagement, of the St. Louis schedule, serves in a sense the purpose of this retainer.

The New York schedule provides definitely for the retainer named in cases which will probably involve the giving of testimony. The St. Louis schedule makes such retainer $100 to $500 or such larger amount as may be commensurate with the financial importance of the case or the labor involved, in addition to the per diem.

All the schedules add to the per diem the cost of surveys, traveling and office expenses. The St. Louis schedule charges expenses and salaries of assistants with an addition of 25 per cent. of such salaries as the charge for general office expenses.

Six hours is considered a day, except that when away from the office 24 hours is a day without reference to the number of hours of actual work on the case.

The New York and San Francisco schedules allow the engineer to estimate his work in advance and make a fixed charge for the whole engagement.

Where charges are made by percentages of the estimated cost of the work to be done, the schedules go into some detail. They differ but little in the total results tho they do have some differences in particular items.

It is interesting to note the comparatively small number of differences in the schedules when one remembers the material differences in conditions under which

the three sets of engineers operate. The differences, as above stated, are very slight in the percentage fees, perhaps because the ordinary employer is not so seriously affected by a percentage as he is by a lump sum or a per diem, not being so familiar with the number of days required by the consulting engineer himself as he is with the three figures representing his per diem charge, so that engineers are able to approach a uniformity of return in all markets more readily by the use of the percentage system.

The New York and San Francisco schedules are prepared by associations of the highest priced consulting engineers in the country and have the flavor of trade agreements to reduce the friction arising in an open market and to increase the general level of prices in their class of engineers. As above stated, they deliberately cut out a very considerable number of consultation engagements on works of minor financial importance, which are thus left open for expert engineers not belonging to these associations who are willing to serve their fellow men at prices not beyond their ability to pay.

The St. Louis schedule is not made by an association and seems to be intended to cover the whole consulting engineering field, and on this account will probably be found more useful by those not members of the associations named. It is open to the objection that it tends to draw all fees down to the level of the lowest named, but these lowest fees are well safeguarded, and the difficulty may be largely imaginary.

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## THEORIES OF THE VALUATION OF PUBLIC SERVICE INDUSTRIES.

There is so much loose reasoning among the experts in the valuation of public service industries that they are getting themselves into muddles which are somewhat entertaining to the observer with a sense of humor, when he recognizes the fact that their difficulties arise mainly from their inability or unwillingness to follow a logical course of reasoning to its legitimate end. Sometimes this looks like unwillingness to seem to knock the props out from under an illogical position of a public service operator. Sometimes it seems to be a sheer inability to see a problem from all its sides and to bring out of the clash of apparently conflicting interests the real agreement which exists at bottom, which, when found, is bound to result in justice to both sides, and therefore in ultimate satisfaction to both.

Take the matter of depreciation, for example. In a recent discussion of this subject before a national association one of these experts presented the following:

I have been asked several times why a company cannot make good depreciation in lump sums out of income, when income becomes large enough so that such depreciation investments can be made good, and especially where the average rate of depreciation was not earned in the early life of the business. It is understood, of course, that these depreciation investments are not additions to capital stock, but are strictly renewals of worn-out or useless structures, and may be regarded as in the nature of replacing a depreciation fund which should have been accumulated, but was not as a matter of fact. It is evident that this is not a true sinking fund, but an attempt to make good such sinking fund. But is it not due to the plant that it should renew itself, as has been held by the Supreme Court of the United States, in the Knoxville case? And may not such renewal be made at other times when the income is available for such replacements?

If depreciation funds have not been set aside from the beginning of the life of a plant, so that in valuing such a plant we must deduct what is lacking from the original investment, it is evident that the property will not be maintained if rates are continually predicated upon the new reduced values so found. This in itself is not unjust from the point of valuation, because if the depreciation has been earned and has not been set aside, the owners have withdrawn it from the plant; but if the valuation should continue every year, such as is usual in California, and no depreciation funds should be accumulated, will not the reduction in investment tend to lessen the rates to a point where they are absurd, because they will be reduced to an exceedingly small theoretical sum, when, as a matter of fact, the plant is as capable as ever of performing the service of pumping water up to the time when it must be renewed? To illustrate: If a plant whose life is three-quarters over should be considered, it will be found that only a very small

diminution in its earning capacity is effected by reason of such depreciation, and while it is possible that a sum should be accruing to replace it at a certain time, it by no means follows that the structure or the machine is not capable of performing almost as good service as ever it did under some conditions. Now, if depreciation were originally applied to such a plant annually on a sinking fund basis, there would certainly arise the incongruity that the value of the plant would be almost extinguished at three-fourths of its life, when in fact its earning power was greater than ever.

Another question has often arisen as to whether rates in the future should be set aside at the same amount as they are calculated for the past. At first blush it would seem the logical thing that they should be computed precisely in the same manner; but upon second thought it will be remembered that we are able to closely follow the actual depreciation which has occurred in the past, knowing all the contingent and surrounding circumstances which have affected the value of the different portions of the plant, while we have no such foreknowledge as to the future. The question therefore arises, are we not justified in computing the past depreciation on a closer basis, that is to say, a narrower margin, than we are in computing depreciation in the future for rating purposes, where we must confront the possibilities of unknown contingencies, the history of which has not yet developed?

In the first paragraph we have the "depreciation fund," "depreciation investments in renewals of worn-out or useless structures," and a "sinking fund" considered as synonymous terms.

The other paragraphs attack the accuracy of the depreciation charge, and attempt to throw doubt upon the validity of its principle on account of the resulting doubt of the method of application of the principle.

It is hard to see any way out of the mire in which this statement is floundering, unless one goes back to first principles, makes some fundamental definitions of terms, and holds to the differences between the terms, at least from end to end of paragraph.

The first question which arises is as to the difference, if any, between a depreciation fund and a sinking fund. The simplest cases have been stated by MUNICIPAL ENGINEERING about as follows, making the necessary assumptions to eliminate all disturbing complications until the principles are thoroughly understood, the preliminary assumption being that there is no loss in the total transaction when finally closed up.

In the first place, we may assume that the plant for a public service industry is constructed entirely with borrowed money. This money is obtained from the sale of bonds which have a definite time to run. Let us further assume that the exact life of the plant is known, and that, like a man, it all goes out of business at once. It is evident, therefore, that the term of the bonds should be the same as the life of the plant and that the plant must earn during its life enough to pay its whole cost, in addition to the cost of operation and maintenance and the interest on the borrowed money.

In the perfect case the managers put aside from the surplus of earnings each year a sum for a sinking fund, which, with the interest obtainable on its investment, will just equal the bonded indebtedness on the day that the bonds become due.

The value of the plant decreases each year by its approach to the day of annihilation, even if it is maintained at the highest possible standard of efficiency. The value of the property of the corporation remains uniform, however, because each year a deposit of cash is made in the sinking fund which offsets the reduction in the value of the plant.

Suppose, now, that the plant is built, not with borrowed money, but with the money of the stockholders themselves. The theory is not changed, for if they are not to lose anything by their operations, they must during the history of the plant receive not only the dividends which represent the interest on the money they have invested, but also the total sum which they have invested. Technically the fund which may be accumulated to make this repayment of the total cost of the plant is not called a sinking fund, although it answers the same purpose, but, for reasons to be shown later, is called a depreciation fund.

Thus, in the simplest case imaginable, the two funds are practically the same, and produce practically the same result, by practically the same means, altho

called by different names. The differences between them are differences in methods of handling the funds, due to the complications which arise from various sources in the practical operation of the plant and of the funds invested in it and received from it.

Suppose that the plant in its early days is not able to meet the annual payments to the sinking or depreciation fund. The preliminary assumption of no loss makes it sure that in later years the plant can make up the deficiency, and, to complete the cycle of transactions, it must make it up. It is evident that the company must "make good depreciation in lump sums out of income when income becomes large enough so that such depreciation investments can be made good." The same is true in the case of the sinking fund. The payments thus to be made must put the funds into the required condition, considering both the direct payments to the fund and the interest accumulations thereon. They are "attempts to make good such sinking fund," and the result is the sinking fund itself.

Now, in making a valuation of the plant for purposes of sale, the entire property of the company should be taken into consideration, and the sinking or depreciation fund is a fundamental part of this property. If the plant is to be sold alone, this fund must be deducted from the total valuation, for the first thing the purchasers at the original price would be required to do would be to reproduce this sinking or depreciation fund. Indeed, a larger deduction should be made because the new owners will not receive the interest during the remainder of the life of the plant upon this accumulation in the fund.

If the valuation is made for rate-making purposes the treatment will be somewhat different. If the depreciation or sinking fund is on hand it must be taken into account as one of the productive assets of the company. If it is not on hand, the reason for the deficiency must be ascertained. If it has been spent in dividends, the income of the company for the future should be enough less to make up for the excess in dividends already received, i. e., the valuation of the plant should be decreased. If it has not been earned, then the valuation of the plant should be such as to give the opportunity to earn it in the future.

In neither of these cases is it necessary to modify the treatment of depreciation, provided opportunity is given to complete the depreciation fund or the sinking fund if they are found deficient. They can be taken care of under the "cost of getting business," if desired. In the latter case the deficiency in income is doubtless due either to lack of business or to expenditures in getting business, and it must be made up in future years. The rate-making process must take this into account, and the Wisconsin Railroad Commission computes additions to the capitalization to offset these deficiencies. On the other hand, in the former case the income has been more than sufficient and the excess has been expended in dividends or their equivalent, instead of being put into the depreciation or sinking fund. This may be treated in the same way except that the "cost of getting business" is a negative quantity and the computation will result in a reduction of the capitalization. This is eminently reasonable in theory, notwithstanding the dictum of another expert in valuations that "a minus going value (development expense) is an absurdity, for it is tantamount to saying that a going concern has less value than one that has just begun." He uses "development expense" and "going value" as exactly synonymous terms, another looseness of definition which is responsible for some errors in courses of reasoning and in conclusions. He also fails to differentiate between the conditions in a plant which makes money from the start and in one which must spend money in developing its business.

Most of the experts fail also to take the only logical position in the treatment of public service industries, viz.: that the monopoly granted carries with it the obligation to supply the service with no more than a reasonable return upon the money, ability and efficiency invested in it.

Complications will arise in the practical application of principles, exemplified by such conditions as the following: The

construction of a plant in part with borrowed money and in part by capital furnished by the stockholders; expenditure of the depreciation fund in renewals and replacements from time to time, as needed; the differentiation between new construction and repairs; the attempt to keep the plant always up to the most efficient condition, so that it will always be a going concern and will never need to be abandoned or entirely renewed at any one time; the assumption of a depreciation rate which wipes out the book value of the plant before it is itself wiped out; the failure to make the proper transfer from depreciation fund to plant value when the depreciation fund is expended; failure to recognize the difference between actual observed depreciation and estimates of past or future depreciation and between effects of errors in these estimates, etc. Some of these complications and their effects will be considered later, we trust by some of our readers as well as by ourselves.

The necessity in the discussion is to keep the fundamental definitions and principles always in mind. The one controlling principle, the justice of which is now quite generally recognized, is that the most economical and most equitable method of treating a public service industry is to make it in fact what it is in theory and must ultimately be in practice, a monopoly. This decision carries with it the necessity of limiting the returns from the operation of the monopoly to a reasonable compensation for the money, time and ability expended in its operation. We have not yet learned exactly how to determine this return, but we are striving toward the knowledge and are making some headway. If we can eliminate all ideas on the one side of undue profits derived, perhaps, under cover of some apparently innocent provision of the franchise, or on the other side, of gaining undue advantages over the operators of the industry, which, if unjust, must ultimately react against the governmental authority or the customers of the plant, we will advance much more rapidly than if we permit self interest or the demands of political manipulators to befog the vision by their specious arguments.

## MUNICIPAL ENGINEERING IN THE WEST.

In order that we may handle our rapidly growing business most advantageously, we have just opened our Western offices, Suite 1945, Commercial National Bank Building, Chicago, under management of Mr. Charles A. Dickens, assisted by Mr. Edw. W. Turk.

MUNICIPAL ENGINEERING'S friends and patrons are cordially invited to make these offices their headquarters while in Chicago. Stenographer and two unlimited service 'phones (Randolph 4652 and 1815) are at their disposal.

We maintain a competent and skilled corps of artists and assistants at our

C. A. DICKENS.

Western headquarters and are prepared to co-operate with our clients to the fullest extent.

Our Western advertising manager, Mr. Dickens, is a grand nephew of the noted author, and has attained an unusual success as an editorial and advertising writer. He has been connected with several leading publications, and during the past seven years, prior to his present connection with MUNICIPAL ENGINEERING, was Western manager of the *Boot and Shoe Recorder*, of Boston.

# THE QUESTION DEPARTMENT

**Articles and Books on Cost of Sewers and Their Engineering.**

Kindly advise me where I can find a book on costs of sewer construction, more particularly what per cent. of total cost goes into engineer on sewer construction in various state.

T., ———, Mass.

Books which have more or less information on cost of sewers and a little incidental information about cost of engineering thereon are Folwell's "Sewerage ($3); the latest edition of Trautwine's "Engineers' Pocket Book" ($5); Gillette and Hill's "Concrete Construction Methods and Costs" ($5); Gillette's "Handbook of Cost Data for Contractors and Engineers" ($5); Ogden's "Sewer Construction" ($3); Staley & Pierson's "Separate System of Sewerage" ($3); Kirkhoffers "Diagram for Estimate of Pipe Sewers" (25 cents); "Handbook for Cement Users" ($3).

Following is a list of articles in recent numbers of MUNICIPAL ENGINEERING which give much information, particularly as to individual projects:

"An Automatic Sewage Pumping Station," xl, 228; "The Mill Creek Intercepting Sewer at Erie, Pa.," xxxix, 176; "Exposed Sewers at Leavenworth, Kan.," xxxix, 347; "Cost of Pipe Sewers," xxxviii, 39; "Early History of Sewers of Memphis, Tenn," xxxvii, 232, giving mileage, cost and percentage cost of engineering each year for about twenty years; "Number of Brick in Sewers," xxxvii, 335, giving data for computation of cost of brick sewers; "Prices of Paving and Sewer Work," xxxvii, 326; "Sewer Plans and Prices," xxxvii, 398; "Concrete Sewer Construction in Chicago," xxxvi, 21; "Methods of Sewer Construction in Clinton, Iowa," xxxvi, 300, giving cost per foot of sewers of various sizes; "Methods and Cost of Constructing Concrete Sewer," xxxv, 71; "Sewer Trenching in Wet Sand," xxxv, 143; Trench Digging," xxxiv, 97, with references to other earlier articles; "A Concrete Sewer in South Bend, Ind." xxxii, 190; "Cost of Concrete Sewers," xxxi, 20, giving references to a number of earlier articles on this subject; "Notes on Sewer Design," xxx, 329. There are numerous articles in earlier numbers which can be listed if desired.

So far as cost of engineering is concerned, the list of articles given in the June number, vol. xlii, p. 470, will give much information. Some of these articles give schedules of fees and some of them give figures of actual cost of municipal engineering. The schedules of fees are made in the hope that they will be used, but there are many engineers in need of business who will accept less. The best method of procedure for a city is to select an engineer with reference to his competency first and treat the matter of fees as a secondary consideration. The chances are very great that satisfactory results will not be obtained by opening an engagement for performing an engineering service to competition, and it is seldom that competent men can be obtained at low prices.

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**Best Material for Village Streets.**

To the list of good materials for village streets, given in the June number, vol. xlii, p. 470, may be added Warrenite, Bitulithic, and Bitustone Double Bond, varieties of bituminous pavements of different costs, which have shown their value for the purpose desired.

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**Automobile Ordinance.**

As city attorney of this city, I have been asked to draft an anti-muffler ordinance to apply to automobiles and motorcycles. This is a place of about 3,000 people, and if you can send me a copy of such an ordinance now in use in any city of about this size it will help me out some.

M. C., ——, Iowa.

No ordinance for so small a city is at hand. The following should be applicable, altho the city is much larger than 3,000 population:

It shall be unlawful for any owner or operator of any automobile or other motor vehicle to maintain or use any searchlight or blinding light on said automobile or other motor vehicle using any of the streets, avenues, alleys or public places within the corporate limits of the city, provided that nothing herein contained shall apply to any automobile used by the police for the city when in the performance of their duties. Any person violating the provisions of this section shall upon conviction thereof be fined in any sum not exceeding $20.

It shall be unlawful for any person, firm or corporation to leave standing in a public street, alley or highway within the limits of the city from one-half hour after sunset to one-half hour after sunrise, any automobile, motor vehicle or other conveyance, carriage, wagon, engine or machine, the motor power of which shall be electricity, steam, gasoline, or any source of energy other than human

or animal power, unless there shall be kept burning on the front of said vehicle at least one white light visible for a distance of not less than 200 feet, and on the rear of said vehicle at least one red light visible for a distance of not less than 200 feet.

No person, driver, or operator, in charge of any automobile or motor vehicle, described in the preceding section shall permit the machinery of said vehicle to run while such vehicle is standing in any street, alley or public highway within said city without an attendant for a longer period of time than 5 minutes at any one time.

No person, firm or corporation shall use upon the streets, alleys or public highways of the city any automobile, motor vehicle, other conveyance, carriage, wagon, engine or machine, the motor power of which shall be steam, gas or gasoline, or any like source of energy, unless such vehicle shall be equipped with a sufficient modern and improved muffler to prevent noise from the exhaust of the engine or engines of such vehicle, and said muffler shall be kept and remain closed by the person operating or in charge of such vehicle at all times when such vehicle is in motion.

Any person, firm or corporation violating any of the provisions of this ordinance shall upon conviction, be fined not less than $1 or more than $100, to which may be added imprisonment not to exceed 6 months in the county jail or workhouse, and upon a second conviction for such offense, said person, firm or corporation shall be fined not less than $25 to which may be added imprisonment not to exceed 6 months in the county jail or workhouse, and upon a third conviction for such offense said person, firm or corporation shall be fined not less than $50, to which shall be added imprisonment for a period of not less than 30 days in the county jail or workhouse.

The city ordinances also have provisions regulating speed, licenses of vehicles and of drivers thereof, and limiting ages of persons who can drive automobiles.

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### Legal Notice to Property Owners to Build Sidewalks.

If we remember correctly, you at one time published an account of a decision rendered by some court about preparing a special assessment for concrete sidewalks that the property owner was not given forty days of god weather in which to build his walk before the city took it in hand. What we would like to know is, does the city have to give the property owner forty days of good weather in which to build his own walk, according to specifications, before the city can stop him from putting it in after they have started to draft the ordinance?

L., ———, Illinois.

The Illinois statute governing the matter, Hurd's Revised Statutes, 1908, part of Sec. 292, provides: "Said ordinance may require all owners of lots or parcels of land touching the line of said proposed sidewalk to construct a sidewalk in front of their respective lots or parcels of land in accordance with the specifications of said ordinance, within 30 days after the mailing of notice of the passage of such ordinance, addressed to the party who paid the last general taxes on the respective lots or parcels; and in default thereof, said city, village or town may furnish the materials and construct said sidewalk in accordance with said ordinance, or may enter into a contract," etc.

This seems to leave the detail to the ordinance passed by the city council, and if that provides for 40 working days then it must be given, otherwise, only the 30 days provided for in the statute would seem to be necessary.

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### Cost of Bituminous Macadam Roads.

Have you any information regarding bituminous macadam roads constructed in Ohio, Indiana, Illinois or Kentucky, which are in good condition regardless of the material used in building; also have you any cost data in connection with same?

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Illinois reports no bituminous macadam roads up to 1910. There were at that time but 48.75 miles of bituminous macadam roads in Indiana, 35 of which are reported from Ohio County, on the Ohio River, which has but 65 miles of improved roads in all and no railroad, and 1.75 miles from the adjoining county. The other 12 miles is reported by Miami County. No figures of cost are given and there is no report of their condition. Kentucky has but 1.7 miles of bituminous macadam road in one county, Boyd, which cost about $5,000 a mile, the treatment being with 2 gallons of oil per square yard. Ohio reports but few miles of bituminous macadam roads, not more than 20, in four counties. These are of better quality, the cost averaging $5,000 in one county, $8,000 in two counties and $10,300 in one county. These figures do not include the experimental road at Columbus. Some of there roads are now more than eight years old, and their present condition is not reported, but is dependent almost entirely on the care which has been taken with their maintenance.

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### Damages for Changing Street Grade.

Will you please give me some information thru the "Question Department" of MUNICIPAL ENGINEERING, on the following subject?

When a city changes the grade of a street, either by lowering or raising the surface of the street, what rights has an abutting property owner, as long as the city authorities do not encroach on his property? This city is threatened by a law suit per several property owners who claim that the changing of street grade has damaged their property. Please give me the opinions of the courts in similar cases. Has this case ever been tried in the state of Tennessee? If so, where and with what result?

M., City Engineer, ——, Tenn.

It will first be necessary to define the meaning of changing a street grade. Sometimes the changing of the level of the street in the process of improving it is called changing the grade and, practically speaking, this is a correct use of the term. Such change is not ordinarily subject to the question of damages on account of making the change, because the changes are made for the general benefit and it is seldom that any property owner affected is allowed damages.

From the legal point of view the term "change of grade" may be restricted to the following process. The municipality adopts a grade for a street, which may be entirely upon paper, no improvement being made to make the grade effective, or the improvement

may be made so that the street is made to conform to this established grade. A property owner may construct a building or a drainage system or any other improvement in conformity with such established grade, whether actually constructed or not. Later, for some reason, especially if the street has not been actually graded, the municipality may desire to change the grade. In such cases there is an opportunity for damage, even if no construction has been made by municipality or property owner and the question of responsibility for such damage arises. There is no fixed rule as to this, the circumstances of the case determining the amount of damages and the responsibility for them. Ordinarily the establishment of a grade justifies a presumption that damage may result from a change in the grade, but the damage must be proved.

The right of a city to change a grade under the first definition thereof given above is affirmed in Morris et al. v. City of Indianapolis, et al. (Ind.), 94 N. E. 705, quoted in MUNICIPAL ENGINEERING, vol. xli, p. 55.

In California the statute requires a petition of a majority of the property owners to give authority for a change of grade. Wilcox v. Engebretson, et al. (Cal.), 116 P. R. 750, quoted in vol. xli, p. 463.

Damages from change of grade arise only from negligent doing of the work. In the particular case a heavy fill was deemed to require a retaining wall to prevent direct damage to the property from the physical act of filling and the cost of a retaining wall was relevant to the inquiry as to damage. Harper v. Town of Lenoir (N. C.), 68 S. E. 228, quoted in vol. xxxix, p. 216.

In an Iowa case, Meardon v. Iowa City, 126 N. W. 939, it is said that the benefits must be considered with the disadvantages in determining the measure of damages from a change of grade. Quoted in vol. xxxix, p. 217.

Non-abutting property owner has heavy burden to prove damages from change of grade and they must be proximate, immediate and substantial. Ogontz Ave. Case, 225 Pa. Supreme Court 129, quoted in vol. xxxviii, p. 52.

In New Jersey damages for change of street grade after erection of building thereon must be limited to the damage to the building only, and not to the entire property. Delaware, L. & W. R. Co. v. City of Summit, 72 A. 83, quoted in vol. xxxvii, p. 117.

An ordinance is required to change the grade of a street which has been established by ordinance. Powel v. City of Excelsior Springs (Mo.), 120 S. W. 106, quoted in vol. xxxvii, p. 337.

In a Minnesota case, Olson v. City of Albert Lea, 119 N. W. 794, the property owner was deemed not entitled to formal notice of expense to adjust his property to the new street resulting from a change of grade. Quoted in vol. xxxvii, p. 44.

In a Missouri case, McGrath v. City of St. Louis, 114 S. W. 611, the property owner was deemed not entitled to formal notice of lowering of alley grade and seems to have been required to support his own building, whose foundations were affected by the excavation of the alley. Quoted in vol. xxxvii, p. 191.

In vol. xxxvi, p. 44, are quoted two decisions, one in Bernhard v. City of Rochester, New York Sup. Ct., to the effect that the legislature has power to compel compensation for damages from changing the grade of a city street; and one in City of Akron v. Huber, Ohio Sup. Ct., that the city is not liable for damages from a reasonable change of grade where no grade had been established prior to the improvement of the property. On p. 121 is a quotation from the decision in District of Columbia v. Atchison, 31 App. D. C. 250, to the effect that the city is not liable for consequential damages caused by change of grade unless the work was done in a negligent manner, in which case it would be liable for the damages caused by its negligence only. On p. 186 is the statement, from the decision in Dorsey v. Town of Henderson (N C.), 62 S. E. 547, that courts cannot go into the question of the advisability of the change of grade, the municipal authorities being the sole judges thereof. On p. 322 is a decision against a subsequent assessment of benefits for improvement from change of grade where special benefits to lots from the regrade were offset against damages in the original proceedings. Schuchard v. City of Seattle (Wash.), 97 P. 1106.

Change of grade cases in Indiana are cited in Thornton's "Law of Cities and Towns," p. 205.

Change of grade cases in New York are cited in the "Consolidated Laws of New York," under the Village Law and also under the Cities Law.

The writer knows of no Tennessee decision on the subject.

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**Law Governing Assessments for Street Improvements in New York Villages.**

This village is a municipal corporation doing business as such, in accordance with the provisions of a special charter granted in 1893 by the state of New York. There is also the Village Law, being chapter 64 of the Consolidated Laws of the State of New York, which applies to villages having special charters, insofar as the provisions of the same do not conflict with the provisions of our special charter.

The village desires to permanently improve some of its streets by the construction of pavements of stone, brick or macadam. This improvement will involve the expenditure of so large an amount, as to require the issue of the bonds of the village. It is desired to compel property owners adjoining the proposed improved streets to pay a portion of the expense of the improvement by special assessment and tax.

The special charter of the village contains no provisions in regard to a special assessment against adjoining property owners for such an improvement, the only reference to such improvement, so far as I observe, being contained in section 2 of Title VIII, which provides "expense of paving," etc., shall be paid out of the fund raised for highway and street purposes,

which is the small annual fund raised for maintenance and repair of all the streets in the village. Section 166 of the Village Law provides, however, a scheme for the paving of village streets and for the assessment of a tax for a portion of the expense of the improvement upon the adjoining property owners.

The principal question to be determined is, whether the village can proceed under the provisions of section 166 of the Village Law, and assess a portion of the expense of the improvement upon the adjoining property owners, and the balance upon the village as a whole. Of course, it will be necessary for the purpose of construction to raise the entire amount immediately by an issue of the bonds of the village; but, in order that the bonds may be sold in the market, it is also necessary that every step of the proceedings leading up to their issue be legal and valid. In this connection, it will probably be necessary to take into consideration the provisions of the General Municipal Law, being chapter 24 of the Consolidated Laws of the State of New York, and the General Construction Law, being chapter 22 of the Consolidated Laws of the State of New York.

F., Village Attorney,
———, N. Y.

This is a question which can be decided authoritatively only by an attorney or official versed in the practice under the improvement laws of the State of New York. For one not expert in such practice, the only answer is the pointing out of the provisions of the laws.

It would seem that under the constitutional provision in New York State, villages incorporated after 1874 were subject to the General Incorporation Act referred to in the question. If incorporated before that date, the town has the privilege of choosing whether it shall operate under its special charter or under the general charter.

The special charter referred to, which assumed its present form in 1893, gives the village authorities no opportunity to expend more than the $2,400 named in it for all street purposes. Streets could be improved by resolution for extraordinary expenditures, which must be submitted to the people. They can also be improved as highways, the board of trustees of the village having the same powers as commissioners of highways in the towns (townships) of the county. Property owners are required to lay sidewalks and curbs, or the board can do this at the property owners' expense on their failure to comply with notice so to do.

If the village elects to act under the general Village Law, the steps of procedure for making street improvements are fully set forth in the law.

It would seem to the outsider that the village could not act under both its special charter and the Village Law, but must choose which it shall follow. The general Village Law makes street improvement comparatively easy, while the special charter makes almost no provision for such improvements, and the provisions of the Village Law lay down quite different methods of inaugurating and carrying thru paving proceedings, as well as different methods of providing for the raising of funds and ultimate payment of assessments and bonds.

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**Ordinances Governing Operation of Interurban Cars.**

Have you any interurban ordinance in print covering the feature of weight on a bridge or limiting the number of cars in a train?

We are also interested in a joint trackage feature of an ordinance.

R. C. H., City Attorney, ———, Ill.

Each interurban or street railway company in Dayton, O., has a different franchise. A provision in one of the street railway franchises touches two of the points mentioned. It reads as follows:

In the event said Peoples Railway Co. makes any traffic arrangement or contract with an interurban or other street railway company or railway company operating cars weighing 15 tons and upward to use its tracks crossing the canal bridge on Valley street, the said Peoples Railway Co. shall remove the present bridge at said point and construct another bridge of the full width of the street sufficiently strong to carry the cars to be operated across it, and the Board of City Affairs shall ..... designate the character, strength and style of the new bridge.

Some of the interurban railway franchises have similar provisions regarding the bridges they wished to use, with the further provision that they shall pay two-fifths of the cost of maintenance of the floor of the bridge.

Dayton has a number of long bridges over its river and several of the street railway franchises have provisions that when the city decides to rebuild the bridges named in the franchises the company shall pay one-third of the cost, and shall also pay one-third of the cost of repairs of the bridges, whether old or new.

The city of Logansport, Ind., provides in one interurban franchise that the bridges crossed shall be strengthened by the company according to plans and specifications prepared by the city engineer. Another franchise requires the company to build independent bridges alongside the city's bridges, this being possible at the particular locations named in the ordinance because of the lack of either public or private improvements of a permanent nature.

As regards joint trackage the following provision in the franchise of the Indianapolis Street Railway Company will be of interest:

And the said party of the second part also agrees and binds itself, its successors and assigns, that it will permit the use of its track or tracks by any incorporated suburban or interurban railroad company authorized by the said act of March 3, 1899, from the corporate limits, or from the nearest connecting point within the corporate limits of said City of Indianapolis to some central point in such city for the purpose of discharging and receiving passengers, with the right of such company to run its cars thereon to some loop and return thereon out of said city whenever such use has been permitted by the Board of Public Works and Common Council of said city, by contract approved by ordinance, and the right is hereby reserved to the said Board of Public Works and Common Council to establish such central point where such passengers

shall be received and discharged, and to designate the track, or tracks, to be used by said suburban or interurban railroad company in going to and from such central point, so to be established as aforesaid in such city. That such use of the said track or tracks shall be upon such conditions and under such regulations as the Board of Public Works and the Common Council of such city shall prescribe, and the terms as to compensation and the question as to the furnishing of power and the maintenance of service shall be determined in conformity to the provisions of Sec. 2 of the act entitled, "An act concerning street railroad companies in cities, the population of which exceeds 100,000," hereinbefore referred to. Provided, That nothing herein contained shall be so construed as to in anywise abridge or restrict the powers now had and held by said Board of Public Works and Common Council to exercise jurisdiction over the streets, alleys, avenues or bridges of said city, or to exercise its power to contract with other companies or corporations concerning the occupation or use of the same.

This provision was later extended in a franchise to the Indianapolis Traction and Terminal Company, the lessee of the above company, to include the use of terminal station erected by the new company providing that

Said passenger terminal shall be accessible to any suburban or interurban railway company directly or by the lines hereinbefore provided to be constructed from the line which said company shall be permitted by the Board of Public Works and Common Council of said city to use in going to and from its central point and terminal in said city, and to permit said terminal to be used by said suburban or interurban railway company for all of the purposes of passenger traffic for which the same may be permitted to be used by the Board of Public Works and Common Council of said city, under such reasonable regulations as may be prescribed by said Traction Company, without discrimination in favor of or against or among or between any of said companies, and for such compensation as shall be agreed upon, or upon failure of agreement, as shall be fixed in the manner prescribed in said act of the General Assembly of March 3, 1899, for fixing compensation to be paid by such suburban and interurban railway companies for the use of the tracks of the Traction Company. The right to such use by any suburban or interurban company shall be upon condition that the compensation for such use, agreed upon or fixed by the court, shall be paid as and when it becomes due and payable, and that such reasonable rules and regulations shall be conformed to, and that for failure to so pay, or to conform to such rules and regulations, and so long as such failure shall continue, the suburban or interurban company so failing may be excluded from such use.

Each interurban company's franchise contains the following provision:

And it is also agreed and understood that the said company shall not permit to be used or operated on its said line within said city any car or cars by any other person or corporation, without the consent of the Board of Public Works entered upon the records of such Board, and until after terms for compensation for such use have been agreed upon with said Indianapolis Street Railway Company and the Indianapolis Traction and Terminal Company, or fixed as provided by law. It is further agreed and understood that the right to use the tracks of said Indianapolis Street Railway Company and the Indianapolis Traction and Terminal Company, hereby granted, is subject to the payment by said company, to said railway companies, respectively, of compensation for such use as fixed by agreement or judgment of the proper court, as and when such compensation shall become due and payable, and that in default of such payment, and so long as such default shall continue, said railway companies, or either of them, shall have the right to exclude said company from such use.

The Board of Public Works reserves the right to approve of routing of cars, or, in case of necessity, to fix such routes.

The writer is not familiar with any provision regarding limiting the number of cars in a train. The practical operation of cars around the sharp curves at street corners in municipalities precludes the use of more than three cars in a train ordinarily, and makes the use of more than two cars very difficult, and is not economical of time or power.

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**Cities Having Police Station Buildings.**

Our city is about to build a police station and we would be pleased to get from you if possible a list of the smaller cities which recently built them so we may look them over, where it is practical to do so.

W., Secretary Police and Fire Com., ———, Mich.

The following cities of 25,000 to 50,000 population have recently increased their investments in police departments from $5,000 to $100,000, much of which is for new station buildings:

Mobile and Montgomery, Ala.; Sacramento, Cal.; New Britain, Conn.; Jacksonville, Fla.; East St. Louis, Rockford and Springfield, Ill.; South Bend, Ind.; Davenport, Iowa; Malden and Newton, Mass.; Joplin, Mo.; South Omaha, Neb.; Atlantic City and Bayonne, N. J.; Oklahoma City, Okla.; Allentown, McKeesport and York, Pa.; Chattanooga, Tenn.; Spokane, Wash.

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**Testing Water Pipes by Compressed Air.**

I would like to receive information as to whether there is any practical method of testing newly laid water mains before covering up by means of compressed air. The idea would be to cap the last pipe laid by a special cap which has provision for attaching the connection from the compressed air, also a connection for attaching the gage.

L., City Engineer, ———, Can.

Can our readers give any instructions from their own experience? Air-tight caps, properly clamped to the ends of the section of pipe to be tested are readily constructed, with taps for attachment of air pipes. Indeed, it should be possible to use the same apparatus which is now used for testing lines of pipe by water pressure. Coffin's specifications for testing gates and suction mains by air pressure applied by an air pump, the trench being filled with water enough to cover the pipe, are given in Goodell's "Water Works for Cities and Towns," ($3). The same method, used by A. L. Holmes in testing leakage, is described in an article on "Submerged Pipe," in MUNICIPAL ENGINEERING, vol. xxiii, p. 275, and is suggested for a particular case in vol. xxviii, p. 384.

# FROM WORKERS IN THE FIELD

**Binder Course for Asphalt Pavement.**

To the Editor of MUNICIPAL ENGINEERING:

Sir—In a recent issue of a certain prominent trade publication, it was stated, with reference to sheet asphalt construction, that the binder course is a useless and absurd expense, its only purpose being to hold the wearing surface in firm contact with the foundation to prevent undue movement and that the recent practice in the West and Canda having a tendency to omit the binder course was a step in the right direction.

White it is, as stated, the purpose of the binder course to prevent movement in the wearing surface, it has another and very valuable mission also. It prevents moisture from attacking the wearing surface from beneath.

It is true that the now almost obsolete "open binder" was of very little advantage in this respect, but with the modern practice of employing a dense binder containing a minimum of voids and which is, in itself, practically a wearing surface, the deleterious action of moisture from beneath is eliminated to a very large extent. Even when the subgrade is properly and thoroughly drained-concrete foundations will exude a moisture under certain atmospheric conditions and around man holes and along car tracks, headers and gutters the opportunity for moisture to get beneath the wearing surface is great. Where no binder is employed, all these liquids as well as that still more injurious solvent, illuminating gas, have easy access to the upper surface. Therefore, the decided advantage of a properly constructed binder course can be readily appreciated.

That the use of a dense binder will materially increase the stability of a sheet asphalt pavement cannot be disputed. The writer cannot recall a single instance where the wearing surface has noticeably shoved when supported by a dense binder, but on the ocntrary, a great many instances have come under his observation where excessive shoving has taken place where the surface mixture was laid directly upon the concrete foundation. Where the concrete is left rough the tendency to shove is materially lessened, but not entirely eliminated.

There are, undoubtedly, instances where the binder course can be omitted without material damage to the pavement, but these instances, unless a paint coat is employed, are the exceptions rather than the rule, and to eliminate the binder course from sheet asphalt construction, generally, would be a serious mistake.

The same article stated further with reference to the wearing surface, that too much bitumen was just as bad in the surface mixture as too little. Experience has demonstrated that an insufficient amount of bitumen is a real detriment, frequently causing the asphalt pavement to crack and disintegrate in a very short time. An excess of bitumen, on the contrary, usually results advantageously. While it produces a pavement which may mark excessively from the standing traffic during the first or second summer, it undoubtedly adds a number of years to the ultimate life of the pavement.

ISAAC VAN TRUMP,
Asphalt Chemist, Chicago, Ill.

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**The Effect of Creosote Oil on Bituminous Fillers for Creosoted Wood Block.**

To the Editor of MUNICIPAL ENGINEERING:

Sir.—With a view of ascertaining the effect of adding creosote oil to bituminous fillers for creosoted wood block a series of experiments was made by taking various bituminous fillers and after taking the melting point of the original material and the penetration at 77 degrees Fahrenheit, 5 per cent. and 10 per cent. creosote oil was added. The melting points and penetrations were again taken and the results obtained as shown in the table below.

These tests indicate that a higher melting point should be required of fillers for creosoted block than for brick and also that a filler of lower penetration at 77 degrees Farenheit can be used with creosoted block than with brick since the creosote oil acts in a manner as a flux, softening the filler and lowering the melting point. It will also be seen from the table that some materials are very much more affected than others, and for this reason it might be good policy to require in a filler specification that the melting point shall not be less than a certain number of degrees, depending on climatic and other conditions, after say 5 per cent. or

10 per cent. creosote oil has been added to it.

The method used for taking the melting point was that recommended by the American Society of Civil Engineers.

TABLE SHOWING THE EFFECT OF ADDING CREOSOTE OIL TO BITUMINOUS FILLERS.

| Designation. | Penetration at 77 Degrees F. | Melting Point. 5 Pct. Creosote. | 10 Pct. Creosote. | Melting Point | Penetration at 77 Degrees F. | Melting Point | Penetration at 77 Degrees F. |
|---|---|---|---|---|---|---|---|
| A ... | 25 | 142 | 138 | .. | 122 | .. | |
| B ... | 20 | 168 | 149 | 34 | 138 | 53 | |
| C ... | 14 | 152 | 136 | 26.5 | 126 | 42 | |
| D ... | 28 | 170 | 168 | 42 | 159 | 54 | |
| E ... | 30 | 292 | 292 | 31 | 266 | 33 | |
| F ... | 35 | 167 | 140 | 57 | 122 | 112 | |
| G ... | 30 | 198 | 187 | 38 | 172 | 52 | |
| H ... | 33 | 169 | 150 | 52 | 136 | 98 | |
| I .... | 28.5 | 190 | 188 | 38 | 168 | 52 | |
| J .... | 20 | 211 | 204 | 23 | 188 | 32 | |
| K ... | 30 | 273 | 234 | 33 | 210 | 36 | |

A B and C are tars.

D, E, F, G, H, I, J and K are asphaltic materials.

HENRY H. MILBURN,
Chemist, Testing Laboratory, Engineering Department, City of Omaha.

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**Concrete Roads—What They Cost.**

To the Editor of MUNICIPAL ENGINEERING:

Sir—The American people will not stand for misrepresentation. It matters not whether it be ignorantly or purposely perpetrated. Tho oftentimes indulged in for the purpose of gain, it will not secure in the long run any benefit to those who indulge in the use of it; but it is the duty, nevertheless, of every patriotic citizen to refute, to deny, and to put truth in the place of falsehood wherever and whenever opportunity occurs, where and when, at least, the citizens' interests are in any way affected. If falsehood and misrepresentation are allowed to pass unchallenged it often happens that persons innocently but carelessly help to distribute misinformation who would not knowingly be guilty of such an oense.

I have heard reputable public speakers assert that they could build a concrete road for $3,500 a mile. In an article in the *Cleveland Motorist,* April 19, Mr. D. S. Humphrey is made to say, in speaking of the concrete roads out of Detroit, that they are being constructed at about $8,000 a mile as against $15,000 to $16,000 a mile for vitrified brick roads.

We have before us the third annual report of the Wayne County Road Commissioners for 1909. In that report the commissioners say they constructed one mile of Woodward road, exactly 5,280 ft. in length, with a concrete width of 18 ft. and 6½ in. deep at a cost of $13,537.59.

In addition to the actual charges in the cost of this road we note in the same article the statement of the commissioners, namely, "Your commisisoners have exercised a close supervision of the work as it progressed, beout and over the road daily."

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|---|---|
| We notice also that the general engineering expenses of the board foot up | $4,612.38 |
| We note again that there were charged off as worn out discarded and depreciated of tools, equipment, etc. | 70.53 |
| Depreciation of same | 3,850.88 |
| Items of expenditure in advertising, salaries, blue prints, etc. | 3,496.89 |
| Total of miscellaneous expenditure | $12,030.68 |
| The report shows a present investment in equipment, machinery, etc., of | $21,821.71 |

The road commissioners doing this work for the county have expended these sums in the execution of their road building work, which represent, in a way, the overhead contractor's expenses, and which would be in case of a contractor doing the work, included in his contract price.

Unquestionably, therefore, a certain portion of this equipment of $21,821.71 and a certain portion of the miscellaneous expenditure of $12,030,66 must be fairly chargeable to the construction of the mile of road which appears to cost as per items directly charged in the report as stated; to-wit, $13,537.59. Just how much one cannot say, but as the board's entire expenditure amounted to but little more than $300,000, a part of which was contract work, this 5,280 feet of concrete road must have shared in this miscellaneous expenditure.

The legitimate cost, therefore, is more than the actual charge of $13,537.59.

The fifth annual report of these same Wayne County Road Commissioners discloses the following as the cost per mile of concrete roads built by them during the current year, from October 1, 1910, to September 30, 1911.

| | |
|---|---|
| Ft. road, 12 feet wide | $10,592.74 |
| Eureka road, 12 feet wide | 9,354.92 |
| Gratiot road, 16 feet wide | 13,157.23 |
| Grand River road, 16 feet wide | 17,824.89 |
| Wayne Road, 15 feet wide | 10,112.12 |
| Van Dyke Road, 15 feet wide | 14,467.45 |
| Michigan Road, 18 feet wide | 17,288.03 |
| Mt. Elliot Road | 14,732.80 |

In this fifth annual report, as in the report of 1909, the overhead or miscellaneous expenditure which is a legitimate charge as a part of the cost of these roads, is as follows:

| | |
|---|---|
| Office expense | $5,689.71 |
| General engineering expense | 6,983.29 |
| New contracting equipment | 21,088.24 |
| Total | $33,761.24 |

This amount if apportioned to each mile built by the commissioners will add to the cost of each mile, approximately, $1,700.

A careful examination of these Wayne county roads discloses clearly that the grading and preliminary preparation for the construction of these roads has required but a minimum expenditure.

Sometimes a misrepresentation or misinformation obtains wide circulation thru a semblance of truth. A name may carry with

it the impression that it is a boy, when it is a girl.

If it is intended by the manipulation of the use of any word or words to deceive, it is a fraudulent act.

The intention of those interested in the sale of this pavement is to create the impression that it is cheap as compared with certain other forms of pavement. By such conduct superiority is recognized in pavements they oppose.

But aside from all this. Is this a cheap and economical pavement? It is, from figures shown, but little if any more economical in the first cost than other pavements of durable and permanent character.

At the very best, these roads cannot be regarded by any prudent man in any other light than experimental. The oldest of them have borne the wear of but two summers, now approaching the third. The one longest in use shows a greater erosion from wear in three years than hundreds of brick streets and roads that are properly built and in evidence, subject to much more severe traffic and covering a period of fifteen and more years.

A close inspection of conditions shows that the coarser aggregates in these roads are regularly being whipped out by the automobile traffic, so that the surface of the roads is full of little pits, from which the aggregates have been drawn.

This in truth and reality, considered in the light of the original cost of such roads, is going on at a rapid rate. The numerous cracks from expansion and contraction, unprotected from any additional wearing surface, widen and ravel out rapidly, the units of the aggregate being so small that they are readily whipped out or worn off.

If the cheapest possible protection to this surface is prepared and applied from any of the asphaltum or tar preparations, such as have been in use in the experiments made in Ann Arbor, Mich., it can be no more effective for the purpose of country highways than it is on the streets of that city. For it is a well known fact that the Ann Arbor streets are subject to very moderate use indeed; and yet this wearing coat on all of the Ann Arbor streets has practically disappeared during the winter, and it is conceded that it must be applied annually, and frequently repaired as well. So this protection is nothing more nor less than a case of annual repair, but which in the case of a country highway 18 feet in width could not possibly cost less than $528 per mile—a sum for annual repairs that no tax-paying community will stand.

Now this is exactly what the taxpaying public of Wayne County have got. This is what the taxpayers of any county in the Union will get in attempting to follow in their footsteps.

As compared with the cost and maintenance of a brick road, instead of the burden being lightened, it is made far more excessive and with a road much less effective for the purpose; as a brick road can be built in compliance with the directions for its construction as published by the National Paving Brick Manufacturers' Association, which will absolutely insure a road without any repairs whatever for a great many years to come.

The artificial wearing surface as recommended by these Wayne County Road Commissioners, is 7 inches deep, with a 1-1½-3 mix. Such a road will cost approximately as much as the most approved type of vitrified brick road, having a 4-inch concrete base of a 1-3-5 mix, a 2-inch sand cushion and a 4-inch wearing surface of brick, with the joints filled with a 1-1 mix, 10 inches deep in all.

The 2-inch sand cushion afforded, almost entirely prevents injury to the brick surface due to the cracking and rupture of the concrete in the foundation.

No one will pretend to question the superiority of the vitrified brick wearing surface, over that of the concrete, even if the action of the automobile should whip out some of the cement concrete from the joints, which is improbable, because of its strength and quality. There is no such thing as whipping out the brick units. To get the brick surface out of the way, it must wear out and that means the undetermined lapse of many years.

There is a certain infatuation to many people in experimentation, but the disposition to do so should not be indulged in except in a very limited way, at the expense of the taxpayer's money. Enough for the experiment is sufficient, but it is a bad proportion to experiment with all or even a considerable portion of what you have.

What the public demands of its officials is a careful and conservative expenditure of money in highway building, that which will afford the largest return for the dollar expended.

The vitrified brick roads are not an experiment. They are in no sense, whatever, theoretical. Hundreds and hundreds of miles of those properly constructed, subject to excessive use, have not called for repairs, covering a period of ten to twenty years, and those moderately well built have called for slight repairs. It is in the truth about and in the proof absolute, found in vitrified brick as a surface wearing material, that our challenge of superiority cannot be met by any other material.

Persons under the halo and surprise of something accomplished beyond their expectations, see in it something above and beyond the extraordinary.

The road commissioners of Wayne County, Michigan, have devloped very suddenly a great contrast in the roads that were, and the roads which they have built and are now. It is wonderful to them, but, with their vision, they are not competent to judge of the highest and best adaptation of highways for future use in this country.

We are in the midst of a revolution in the use of highways and this condition is supplemented and aggravated by a revolution of ideas in which are to be seen the wide extended advantages of the public highway to our civilization never before appreciated.

The roads must be built with the economy in the first instance, meeting all of the requirements of the coming transportation, yet with that durable quality without which every hope in this direction must fail.

In the light of what is possible and what has been accomplished, in the building of highways that so nearly eliminate maintenance charges, the Wayne County roads at their best, in their present condition, and in the promise they bear for future worth, are comparative failures.

The one foreboding aspect spectering the enthusiasm with which taxes are levied and bonds are issued, for the improvement of our streets and highways, is the wastefulness of money in the purchase of the roads that are not worth the cash paid for them and if greater caution and the utmost wisdom is not to be exercised henceforth, the source from which the money is being so bountifully supplied will dry up, the enthusiasm subside and road and street building will be greatly hindered and delayed, and in all probability, cease for a time.

It does not avail any information or benefit either to the public or engineers, to give any weight to the failures in any kind of road construction or road building, that will occur from time to time through ignorance or unskillful workmanship.

One of the Wayne County roads which was let by contract is a serious failure. Like results occur in the construction of other roads. It requires a certain amount of skill and especially requires disposition on the part of the contractor and his workmen to follow the instructions to build any road at its best.

In this discussion, however, we are not taking into consideration any exceptional failure. We are only looking to such roads as seem to be built at their best, which is the only way out of which a final and best conclusion can be reached.

WILL P. BLAIR,
Cleveland, O.

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**Monuments and Maps for Locating Water Mains and Appurtenances.**

To the Editor of MUNICIPAL ENGINEERING:

Sir.—In regard to T. R. M.'s request on page 392 of the May number of MUNICIPAL ENGINEERING, in regard to maps for locating valves, dead ends, etc.

Draw a map of the town to scale. With streets 60 feet wide, 100 feet to the inch is large enough. On the map plat the pipe lines to scale, also locating the valves, etc. Indicate the water pipe lines in blue. Have some letter like V for valves, D E for dead ends, or simply E.

From any good permanent objects such as telephone poles, corners of buildings, block corner stakes, etc., take ties or perpendicular offsets and put the distances on the map.

If the town has permanent range points or lines from which to locate lots and blocks, the points make good references.

I herewith send a small sketch to show the meaning of my letter. The valves are in impossible places, possibly, but I merely wished to indicate the method. The scale of the plat is shown. The streets are 60 feet wide. Block corner stakes and fence posts are undesirable on account of possible destruction when buildings are erected. Corners of buildings are good if near enough. The water pipes are supposed to be parallel with the sides of the streets and on the sketch are 25 feet from the lot lines. Thinking this may help T. R. M., I herewith send to him through you.

W. A. PECK, C. E.
1643 Champa St., Denver, Colo.

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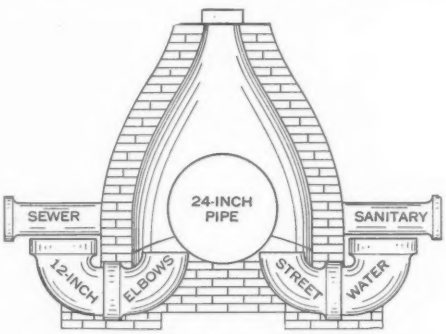
**Inlet to Sewer for Street Water.**

To the Editor of MUNICIPAL ENGINEERING:

Sir.—I would like to have your opinion on the inclosed sketch. After going over the old style street catch basin, I formed this plan. I have about 25 of them in use, and they never have given me one minute's trouble or expense in two years. I never have any dirt or trash to take out of them; they seem to be self-cleaning.




SEWER INLET FOR STREET WATER.

My sewer grade is 2 inches to 100 feet (24-inch pipe). The inclosed diagram is self-explaining. We have just bonded the city for $15,000 to extend our drain and sanitary sewer system.

C. E. HARRIS, C. E.
Apalachicola, Fla.

The plan for sewer inlet shown is apparently justified by its success. When sewers have sufficient grade and flow to permit the admission of street water directly without removal of such materials as would be collected in catch basins, the inlets should be trapped and so planned as to be as nearly self-cleaning as possible. There is more force to the water to keep the trap clean when the trap is at the bottom of the inlet pipe as shown, and the line will therefore keep itself cleaner under ordinary circumstances. On the other hand, it will be more

difficult to reach the upper side of the trap to clean it in case a stick too long to get through the trap, obstructs the passage and causes the closure of the trap to the flow of water. A grating at the street level would reduce the chances for this, provided boys do not put such materials through the grating. If there is plenty of water running in the 24-inch pipe, say half full or thereabout, the sewage will have velocity sufficient to keep the sewer clean.

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**Beneficial Effect of Forests on Stream Flow.**

That the forest cover of the White Mountains has a distinct and measurable effect upon the navigable streams which head in that region is the unequivocal and emphatic statement of the United States Geological Survey.

The report is based on the results of exhaustive investigations and specific field tests which have been carried on during the last year. The investigations are believed to solve definitely a problem that has long been a source of strenuous contention among scientists, and while these investigations have direct reference to the entire White Mountain area, they establish a principle which is of far wider application.

In the southern Appalachian Mountains tracts aggregating 1,962,800 acres have been certified to by the Geological Survey as affecting the navigability of streams by reason of the excessive erosion which follows deforestation in these areas. Owing to the geologic conditions in the White Mountains, no excessive erosion, according to the Survey geologists, can be shown to follow deforestation. Therefore the Survey carried forward its further investigation in the White Mountains along the lines of trying to show that deforestation and subsequent burning of the forest mulch results in a more rapid run-off and therefore tends to make unstable the flow of streams.

The hydrometric showing presented in the preliminary report covers results on two small, almost exactly similar drainage basins of about 5 square miles each, on the east branch of Pemigewasset River, one largely clothed with virgin timber and the other deforested and burned. The facts observed are so striking as to render the position of the Survey impregnable. Careful measurements of precipitation over the areas and of the run-off of the respective streams show that not only was the snow held better in the forested area, but that during a period of 17 days in April, including three extended storms, the run-off of the stream in the deforested area was a comparative flood—practically double that of the stream flowing thru the forested area. The run-off of Shoal Pond Brook (forested area) during three storms in April, 1912, was 6.48 inches. That of Burnt Brook (deforested area) during same storms was 12.87 inches.

In the Shoal Pond Brook basin (the forested area) the Survey established 7 rain gages and 20 snow gages and the engineers visited these continually during the winter on snowshoes, the snow being from 4 to 7 feet deep; in the adjoining Burnt Brook basin (the deforested area) it established 9 rain gages and 18 snow gages. On both streams hydrometric stations were established and the stream flow determined with a high degree of accuracy. The Survey report shows that the maximum flood from the forested basin was only 67 per cent. of that from the deforested basin.

During the period of these storms Burnt Brook (deforested) contributed a much greater volume of water to Pemigewasset River than did Shoal Pond Brook (forested). "The stream of the forested basin is observed to be the steadier of the two and in proportion to its drainage area it tends—at least during the spring months—to promote a steady flow of water in the master stream of which it is a tributary."

The conclusions of Director George Otis Smith, of the Survey, are as follows:

"The comparison between two adjacent basins during critical periods is presented in this preliminary statement as a sufficient showing for the purposes of the National Forest Reservation Commission. While data covering longer periods for both these and other basins in the White Mountains have been collected and will be available for the more complete report, the particular case of the Burnt Brook and Shoal Pond Brook basins is typical for the region and establishes the general conclusion that a direct relation exists between forest cover and stream regulation.

"The results of the Burnt Brook-Shoal Pond Brook studies are held to show that thruout the White Mountains the removal of forest growth must be expected to decrease the natural steadiness of dependent streams during the spring months at least."

Such an actual demonstration and quantitative measure of the performance of different areas, some forested and others deforested, has never been attempted in trying to determine the effect of forest cover on stream flow. Efforts to arrive at definite conclusions have always been based on a study of long-time records of precipitation and stream discharge; but owing to the many qualifying factors, such efforts have simply resulted in divergent opinions and inconclusive controversies. The results of the present actual measurements in these mimic drainage basins, so accurate and refined in method as to approach laboratory experiments, where exact results may be expected, leave no doubt as to the conclusion. Forest cover and the resulting forest mat in the White Mountain granite area does, to a considerable and measurable degree, steady and regulate stream flow, and therefore must be stated as an important factor in maintaining the navigability of streams whose headwaters lie in such areas.

# MUNICIPAL MATTERS IN COURT

**Water Service Connections.**

In a decision rendered by the Supreme Court of the United States on April 1, 1912, a judgment, requiring a water company to make its own service connections, was affirmed.

In the case in question, the Consumers Water Company, of Coeur d'Alene, Idaho, had of its own free will and accord, and altho not required to do so by its franchise, laid a water main on Third street, an ungraded street of the village, now city of Coeur d'Alene. A citizen, Albert L. Hatch, erected a dwelling upon a lot situated on this street and laid a water pipe to the curb in front of his property. He then applied to the water company to connect the pipe at the curb line with its service main, so that a regular supply of water might be obtained. The water company, however, declined to make the desired connection, because of the refusal of Hatch to pay, as required by the regulations of the company, $8.50, the cost of making the connection, or to comply with alternative regulations adopted for the purpose of enabling the water company to recover such cost. An action in mandamus was then commenced in the Supreme Court of Idaho, and culminated in a judgment, in substance finding the regulations requiring a consumer to pay for service connections unreasonable, and ordering the water company to make the connection at its own cost, and to supply water to the premises of Hatch upon payment of the established monthly rate. This writ of error was then prosecuted upon the assumption that rights of the water company, protected by the constitution of the United States, had been wrongfully invaded.

The grounds for the claim in question were in substance that, as the water company was not required by its charter in express terms to make a service connection, and the benefits of such connection would inure solely to the house owner, to compel the water company to bear the cost of the connection would amount to a confiscation of its property, in violation of the due-process clause of the fourteenth amendment, and also would be to impair the obligation of its contract. A further claim of impairment of contract was based upon the contention that, as it was optional with the water company, under its franchise, to lay mains in ungraded streets, there was no duty to supply water from a main voluntarily placed in an ungraded street.

In the opinion of the Supreme Court, which was delivered by Chief Justice White, these contentions were held to be devoid of merit. The court held that it was the duty of the company, under its charter, to make the service connections for Hatch at its own cost. This was based upon the view that, as it was clearly settled by both the statute law and decisions at the time the charter was granted that it was the duty of the water company to make service connections; and its further duty being to supply water to consumers, by necessary implication the charter imposed the obligation to pay the cost of the service connection which it was incumbent upon the company to make; and that the fourteenth amendment had not been violated by the order of the Supreme Court of Idaho to that effect.

As respects the claim based upon the clause of the charter, which provided that the water company should not be "required" to extend its distributing system in any ungraded street or alley within the then village (now city) of Coeur d'Alene. It was held that there was nothing supporting the claim of impairment of contract, because the Supreme Court of Idaho was clearly right in deciding that no contract provision was impaired, since the water company had voluntarily laid its main in the ungraded street in question, and was supplying water from such main to residents on the street, and its duty was to supply water "without distinction of persons." Consumers Company, Ltd., Plff. in Err, v. Albert L. Hatch, 32 Supreme Court Reporter 465.

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**Decisions of the Higher Courts of Interest to Municipalities.**

Assessing Cost of Cross Walks Against Corner Property Constitutes Fraud in Assessment.—A contractor was required by the city to give bond to observe the regulations adopted by the council in doing the work and the directions of the city engineer, among

which was one that he would not construct a walk, unless through to the curb line. The engineer was forbidden from laying out the grades until the owners of corner lots agreed to construct and pay for the cross walks, the cost of which the city was not authorized by statute to impose upon the corner or other lots. Held, that the attempt to assess the cost of crosswalks against corner lots amounted to a fraud, which was ground for enjoining the levy of the assessment. Kagnor v. City of Cedar Falls et al. (Ia.) 135 N. W. R. 564.

A Declaratory Ordinance of Intention is Sufficient to Initiate Proceedings for Public Improvements.—A declaratory ordinance of intention of a city to construct a sewer between designated streets, along each of the alleys bisecting the numbered blocks, which provides that the improvement is for the exclusive use of the property abutting on and approximate to the streets and alleys designated, and which fixes the limits of the district by reference to such streets and alleys, and which provides that the cost will be assessed against the property benefited, is sufficient to initiate proceedings. Collins et al. v. City of Ellensburg et al. (Wash.) 122 P. R. 1010.

Requirements Prior to Tax for Public Improvements.—Where the mayor of a city constructing a sewer took charge of the construction work and called to his assistance a competent engineer, who did the work under the personal supervision of the mayor, who was constantly in direct supervision of it, and the engineer submitted a report of the completion and cost of the work to the mayor, who in turn verified the computation and submitted it to the municipal authorities as his own computation, and they accepted and approved of it and ordered the issuance of tax bills, there was a substantial compliance with the statute requiring an engineer or other officer to have charge of the work, who shall compute the whole cost thereof; the mayor being an officer in charge of the work. Gratz v. City of Kirkwood et al. (Mo.) 145 S. W. R. 870.

Tax Bills for Improvement Are Not Void on Ground of Exceeding Estimate.—Where the estimate of the cost of the construction of a sewer totaled in gross a specified sum, and the details thereof were of service only as specifications of the particular work to be done, and a bid for the work totaled a less sum, though the price of some of the items exceeded the estimate thereof, and the amount allowed the bidder obtaining the contract for the work was less than the bid, the special tax bills issued for the cost of the work were not void, on the ground that the cost of the work exceeded the estimate, within a statute providing that no contract shall be entered into for any work for a price exceeding the estimate; an "estimate" meaning a rough calculation. Gratz v. City of Kirkwood et al. (Mo.) 145 S. W. R. 870.

Bond to Secure Operation of a Public Service Plant is Liquidated Damages.—Under a municipal franchise to operate gas works in a city, which required grantee to give a bond for $5,000 to secure that the plant should be in operation within one year after granting of the franchise, providing that such sum should be considered liquidated damages, in a suit after abandonment of the franchise, brought on the bond given under such provision, that sum must be treated as liquidated damages, and not merely as a penalty. Grayson et al. v. City of Marshall (Tex.) 145 S. W. R. 1034.

Establishing and Locating Street Lights.—A provision in a municipal gas franchise that the grantee should, if directed by the city, install and maintain street lamps at such points as should be selected by the authorities at a specified rate, did not obligate the city to allow the grantee to furnish any number of lights; the matter of establishing and locating the lights being optional with the city. Grayson et al. v. City of Marshall (Tex.) 145 S. W. R. 1034.

Damages Due to Public Improvement.—The true measure of damages to a lot abutting on a street, occasioned by a change in the grade line of the street, is the difference between the value of the lot immediately before and its value immediately after the street improvement, less any special or peculiar benefits to the lot because of the improvement of the street, but leaving out of account such general benefits as accrue to it in common with other proper similarly situated. Rutherford v. City of Williamson (W. Va.) 74 S. E. R. 682.

Bitulithic is a "Kind of Pavement" as Distinguished from Sheet Asphalt.—A bitulithic pavement consisting of a stone foundation upon which rest layers of small stone coated with coal tar, pitch, asphalt, or a mixture thereof or other equivalent bituminous material, which pavement is patented, is a "kind of pavement," as distinguished from a sheet asphalt pavement, and not merely a different make, style, or brand of the same kind. Union Paving Co. et al. v. Board of Contract and Supplies of City of Schenectady et al., N. Y. S. 740.

Issuance of Permit for Sinking Shafts Does Not Render City Liable for Damages Due to Contractor.—The fact that a city issued permits for the sinking of shafts from the surface of the street along the line of an excavation, which it authorized a contractor to make, would not make the city liable for negligence of the contractor in constructing the excavation, whereby he broke into a water pipe; such shafts not having contributed to the breaking of the pipe. Von Lengerke et al. v. City of New York et al. (N. Y.) 134 N. Y. S. 832.

A Water Company Does Not Exhaust Right of Condemnation Upon One Case.—The right of a water company to condemn land is not exhausted by a single condemnation, where the condemnation of other land is necessary to supply the increasing need of the public. Burkhard et al. v. Pennsylvania Water Co. (Pa.) 82 A. R. 1120.

# MOTOR VEHICLES

**Motor Fire Apparatus in Indianapolis.**

Beginning with the purchase of a motor squad car in January, 1911, automobile apparatus has steadily increased in favor with the Indianapolis Fire Department, until it is doubtful if any fire apparatus other than that which is motor propelled will be purchased in the future. The types of motor apparatus chosen up to the present time and the location of the different pieces in the various fire houses are to be commended, and not a little of the efficiency of the apparatus and its consequent favor with the department, is due to these factors. There are now seven pieces of automobile apparatus in service, including the chief's car, and of these, four machines are stationed at the department headquarters in the business district.

Squad car No. 1, shown at the left of the first photograph, was the pioneer of Indianapolis motor apparatus, and has been in service about 17 months. It is of the "auxiliary" or "flying squad" type of machine, which is so efficient in the more congested districts of cities. The chassis is the standard Packard "30," having instead of the seven passenger body, a special body with a driver's seat and two longitudinal seats at the sides with rails and running boards and a chemical tank mounted back of the driver's seat. The chemical tank is of the "soda and acid" type of 35 gallons capacity and with 250 feet of ¾-inch hose. The weight of the machine alone is 5,020 lbs., and with the six men who compose the squad in service the weight is slightly over 6,000 lbs. It is capable of making a speed of 60 miles an hour. During the time this apparatus has been in service it has covered effectively a wide range of territory, and ever since the addition of a second squad wagon it covers the business district, four miles to the north, three and one-half miles to the east and three miles to the west on first alarm. Of a total of 328 fire alarm boxes, Squad No. 1 answers 168 on first and 313 on second alarm.

An American La France combination hose and chemical apparatus is stationed at headquarters. It replaced a similar machine, which was moved into the residence district on May 14 of this year. It is a heavy machine, weighing about 9,500 lbs. when carrying the 7 seven men who compose the company. The engine is rated at 72 horse power. The frame and body are made particularly heavy to carry the equipment, consisting of a 40-gallon chemical tank, 200 feet of ¾-inch chemical hose, 900 feet of standard 2½-inch hose, hand extinguishers, tools and a squad of seven men. The front wheels have 38x4½-inch "airless" tires, that is, solid tires, having transverse cells to allow greater resiliency. The rear wheels are equipped with two each of the same size and kind of tire. The machine is chain driven, and has under test developed a speed of 60 miles an hour.

The third fire fighting machine stationed at headquarters is a Mais hook and ladder truck, shown in the second photograph. It is a stock chassis with special wheels and body. The motor, a four-cylinder standard make, is rated at 30 horse power, and can drive the truck at a speed of from 30 to 40 miles an hour. The truck has a number of special features worthy of note. Two rear axles are provided, one of which supports the weight of the truck while the other by means of an internal gear on the rear wheels, furnishes the driving power. The tires, as will be noted from the photograph, are very large (38-inch by 8-inch) pneumatics with irregularly surfaced treads. They are inflated to a pressure of 160 pounds per square inch. The weight of the truck complete is 7,450 pounds and with 6 men is 8,545 pounds. It carries the following equipment: One 35-ft. extension ladder with two 20-ft. sections; one 30-ft. extension ladder with two 17-ft. sections; one 20-ft. wall ladder; one 18-ft. wall ladder; one 15-ft. trussed ladder; one 12-ft. roof ladder with folding hooks; two fire hooks and holders; two perforated steel baskets and axes; two 6-gal. hand fire extinguishers; crowbars; plaster hooks; nozzle plugs; a 10-inch locomotive bell; one 9-inch revolving searchlight mounted on dash, and a large tool box.

The combination chemical and hose apparatus, which is shown next to squad wagon No. 1 in the first photograph, was on June 1st, moved to station No. 5, about a mile from headquarters, into the wealthier residence district. It is an American La-France machine similar to the one previously described, except for a few later improvements which have been added to the newer

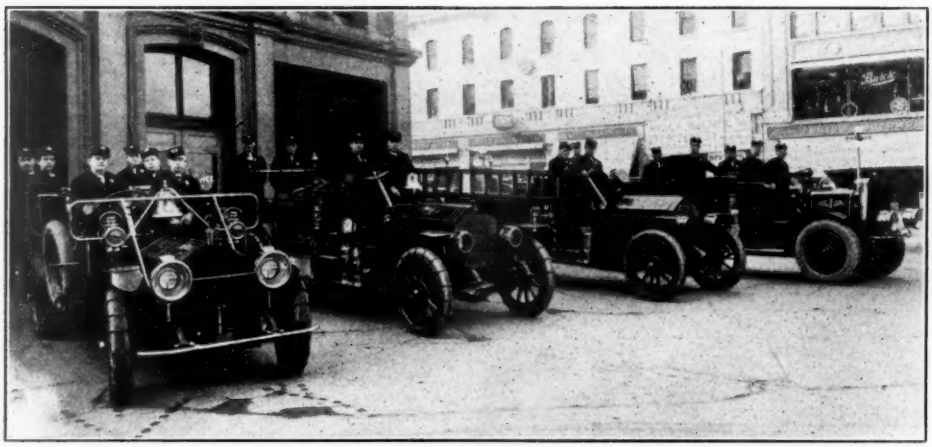
machine. Its equipment consists of a 35-gallon chemical tank, 250 feet of ¾-inch hose, 800 feet of 2½-inch hose, light tools and hand extinguishers.

In the extreme northern part of the city a new "bungalow" style firehouse, built to harmonize with the class of residences in that district, was constructed to house an American La France motor combination pumping engine and hose truck. The engine is of the same size as those on the combination chemical cars. It has a chain drive, and is capable of making the same speed, namely 60 miles an hour, when carrying the company and full equipment. A rotary impeller pump geared to the driving shaft is placed directly behind the driver's seat. This pump has delivered on test 500 gallons of water with a pressure at the engine of 190 pounds, practically the same as a third size steamer. It is provided with two-way connections, so that two lines of hose can be attached. An automatic relief valve allows of the discharge pipes being suddenly closed without injury to the pump. The apparatus carries, in addition to the pump, equipment consisting of 1,000 feet of 2½-inch hose, a 20-foot extension ladder, a 10-foot scaling ladder, and two 4-gallon chemicals.

In the south business and wholesale district is the largest station in the city. It houses thirty men, with Assistant Chief Barrett, four pieces of horse-drawn apparatus and squad car No. 2. It has also a Packard stock 30-horsepower engine of the latest type, dual ignition, and dash adjustment on the carbureter. The equipment consists of a 35-gallon chemical tank, "soda and acid" type, 250 feet of chemical hose, hand extinguishers and light tools. A special frame and heavy spring system are provided for the weight which is carried. The car weighs 5,200 pounds without the men.

The officials of the Board of Safety, the officers and men of the fire department, all express their entire satisfaction with the motor apparatus. Some even state that some regret is felt on account of the purchase of two horse-drawn steamers, simultaneously with the later motor apparatus. The speed with which the automobile pieces cover the ground brings them to the fire ahead of the horse-drawn apparatus, and often the chemicals can "knock down" an incipient blaze which with a few minutes' lost time, would require tons of water to extinguish.

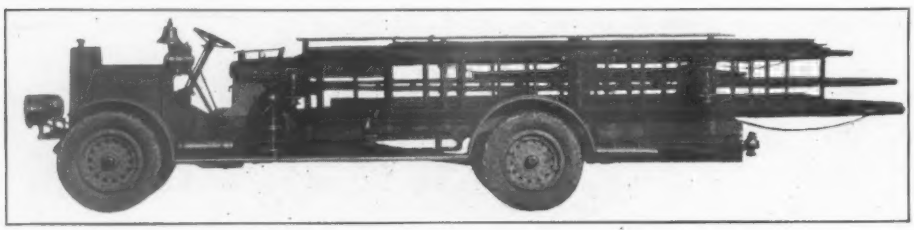
The quick-moving motor pumping engine is stationed in a district which is built up with costly houses set at a great distance apart and served by hydrants which are seldom near, and in some cases there are only wells and cisterns from which to draw water for fire fighting. The pressure maintained at these hydrants is usually adequate for service near at hand, but in cases where the hydrants are remote from the fire, the pumping engine can lay out a thousand or more feet of hose to their suction line and deliver water at fire pressure. This pumping engine covers a territory extending two miles south into the densely-settled residence district, about three miles to the west with an amusement park at its extremity, three miles to the east into the railroad, shop and factory districts, and a mile or more north into the sparsely settled residence section. It is the only practical equipment for work in this territory. It is, of course, reinforced by horse-drawn apparatus at a number of stations, but it gives excellent protection service to the portions covered. A minor feature which has been found to give ex-




MOTOR APPARATUS AT INDIANAPOLIS FIRE DEPARTMENT HEADQUARTERS.

cellent assistance on night runs is a searchlight controlled from the driver's seat. It enables the men to pick out house numbers and street signs when running on "still" alarms and provides assistance to the firemen in working at the scene of the fire. Finally in the case of large fires requiring several pumping engines, the motor pump and hose car can be first on the ground and have several lines of hose laid preparatory to the arrival of the other apparatus. Captain Blackwell is in command of the combination pumping engine and hose car.

The two combination chemical and hose wagons are also well placed. The one which is at headquarters covers a comparatively narrow strip thru the business section and factory district and extending to Irvington on the east and Haughville on the west, the two being small suburbs connected by a few built-up streets to the city. The distances to these suburbs are three miles and five and one-half miles respectively. The second combination chemical is in the residence district and covers about 20 square miles,



MAIS HOOK AND LADDER TRUCK.

the most distant alarm box being something over four and one-half miles from the station. The work which these two pieces of apparatus perform is to arrive on the scene of the fire before the blaze has gained much headway, in which case the chemical tank is effective. Failing in this, sufficient hose and a number of men capable of laying a number of hose lines are at hand for immediate service. In the case of a recent fire in the business section, which started in the rear of a large book and stationery store, the motor combination chemicals and squad-car chemicals extinguished a blaze which in a very short time would have gained such headway as to cause great water damage if not a serious conflagration. Captain Lowes and Captain Hoyle have charge of the two combination chemicals.

The fast Mais hook and ladder truck is able to reach a fire almost as soon as the motor hose wagons. This renders the ladders available for service in most cases, long before the arrival of the horse-drawn trucks. It has been found in actual service that the combination cars, and the squad apparatus cover about five times as much space in a given interval, as the horse-drawn equipment. The motor hook and ladder truck is four times as rapid on long runs as the horse-drawn ladder truck and can, moreover, cover a much greater territory. Captain Love is in charge of this machine.

The squad cars, a type of apparatus which has been developed by the use of the automobile, are, from the nature of their service, the most efficient of the motor equipment. Squad No. 2, which is stationed south of the business section and in the factory and warehouse district, covers 94 boxes on first alarm in this crowded section. The territory covered is about 3 miles by 4 miles, all among this same class of buildings, namely, factories, warehouses and crowded dwellings. In describing the work of squad No. 2, Captain Call mentions the following points in which their type of apparatus is efficient:

Small fires can, by reason of the quickness with which they arrive on the ground, be extinguished by the chemicals.

The men are available, in the case of larger fires, for detail to the other companies. Their training enables them to reinforce hose, steamer or aerial companies.

At times when the squad car is not in service it is occasionally driven about over the territory which they cover and the men familiarize themselves with the location of all public hydrants, those hydrants connected with the private water supply of large manufacturing concerns, and the method of approaching and handling particular hazards. This feature makes for higher efficiency in the men and renders their service more prompt and sure.

Since the installation of squad car No. 2, in February, it has covered a total of 719 miles, which mileage is divided into runs to fires and the scout service, outlined above. Some idea of the comparative mileage is given from the following:

| | Fires. | Miscellaneous. |
|---|---|---|
| February | 38.3 | 50 |
| March | 19.3 | 57.1 |
| April | 16.5 | 70.9 |
| May | 22.8 | 53.8 |
| Until June 15th | 10.0 | 124.4 |

The higher mileage in June was due to

testing out the machine with some new improvements on the engine.

Squad car No. 1 has been the longest in service, having been located at headquarters since January 7, 1911. Captain Fulmer, who was put in charge of the car at that time, has been with it continuously since then. In addition to the points before noted wherein the squad car is valuable, Captain Fulmer mentions the ability to respond to an alarm immediately following a run; the perfect control of the machine which renders both the apparatus and other traffic more safe when making a run; and the lack of that sympathy for the horses which makes a driver hesitate to "crowd" them on long runs. Another service of the men on the squad car is to act as a supplementary company on large fires, gathering the few remaining sections of hose from a number of hose wagons to lay an additional or "bum" line to the fire.

Squad car No. 1 has made a total of 1,547 miles, divided as follows:

| | Fire Mileage. | Miscellaneous. |
|---|---|---|
| Total 1911 ..... | 751.9 | 260.8 |
| Until June, 1912 .... | 423.8 | 100.5 |

The total cost of gasoline during 1911 was $37.60. For gasoline, oil, heavy and light, and alcohol for the radiator in cold weather, etc., the total cost averaged $4.23 per month. The cost item for tires has not been appreciable as one free replacement and some retreading has been the extent of the repairs of this class.

All the machines are well maintained, all of the minor repairs being made by the drivers. The effect of the motor apparatus upon the spirit of the men in charge, the knowledge that they can place perfect dependence on their machines, and the corresponding increase in the company efficiency are by no means the smallest items in favor of the motor appaartus. Automobile fire fighting machines have slowly and surely proved their worth to the Indianapolis department and it is doubtful if in future any horse-drawn apparatus will be purchased. The next addition to the department will probably be a chief's car and after that motor apparatus will replace each horse-drawn unit as it passes its period of usefulness or is disposed of.

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**Motor Garbage Trucks in Homestead, Pa.**

After considerable investigation by the sanitary committee of the city council, the city of Homestead, Pa., purchased a five-ton motor truck for collecting garbage and hauling it to the disposal plant. The truck was delivered early in June, and after a day's preliminary trial it was put in service regularly.

It was found that, owing to the saving of time in going to and from the disposal plant, a more frequent and systematic collection could be made. The hill-climbing ability of the truck, taken with the greater capacity and speed, has made its superiority over the horse and wagon even more pronounced.

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**Additional Motor Apparatus for New York City.**

With the purchase of two automobile hook and ladder trucks on June 18, the total number of pieces of motor fire apparatus in New York City was brought up to twelve. Under direction of Fire Commissioner Johnson, motor apparatus, and particularly the heavier fire fighting machines, are being given a thoro trial with the result that the city is replacing horse-drawn apparatus as fast as conditions warrant.

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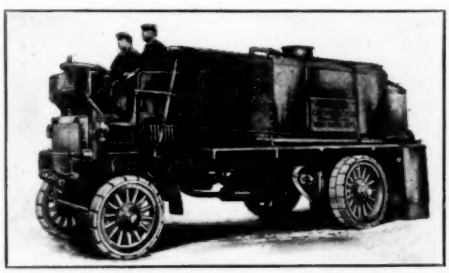
**A Motor Road Oil Distributer.**

To insure the best results from oil treatment, it has been found necessary that the upper surface of the roadbed be uniformly saturated with the oil; and one of the most satisfactory ways of accomplishing this is by means of the power-operated pump, which sprays the oil under pressure equally over the entire roadbed.

The first motor truck ever built in this country, equipped with this system of oil-spraying devices for road work, is shown in the photograph. It was made by the Knox Automobile Company, of Springfield, Mass.,



MOTOR ROAD OIL DISTRIBUTER.

for the American Car Sprinkler Company, of Worcester, Mass., and has now been in service over a year.

It is equipped with a tank holding about 1,200 gallons of oil, and has a powerful circulating pump driven directly from the transmission shaft, forcing the oil under pressure thru a series of small nozzles, so arranged as to secure a very uniform distribution. The pump can be readily thrown in or out of action instantly by the driver, and the nozzles also regulated without leaving the seat.

# ORGANIZATIONS & INDIVIDUALS

**The Convention of the American Water Works Association.**

The thirty- second annual convention of the American Water Works Association was held in the Seelbach Hotel, Louisville, Ky., on June 3-8. The sessions were marked by a full attendance of members, guests and manufacturers' representatives. The registered attendance was 560, of which number about 250 were active members of the association. Dow R. Gwinn, of Terre Haute, Ind., first vice-president, presided in the absence of Alexander Milne, St. Catherines, Ont., president.

The first day of the convention was devoted to committee meetings, and a reception by the Engineers and Architects' Club of Louisville. The second day was divided into morning and evening sessions, with a visit to the Cherokee pumping station of the Louisville Water Company in the afternoon. In the morning session the following committees reported: Publication, standard specification, electrolysis, uniform accounts for water works, national department of health and permanent headquarters. At the evening session Edward Wegmann read a very interesting paper on "Ancient and Modern Water Works." This paper was illustrated by means of lantern slides, showing the famous aqueducts of the Romans and Greeks and other contemporaneous peoples. These works, the greatest of ancient times, were compared with the modern New York City system. William W. Brush also presented a paper, "Floor Area as a Basis for Estimating Consumption," which is given on page 25 of this issue.

The morning of the third day was devoted to discussion of a number of questions, which had been submitted for consideration, and to the election of officers. In the afternoon Captain H. G. H. Ton read a paper entitled "More Than Fifty Years of Reminiscence in Water Works," followed by a paper presented by a representative of I. M. de Varona on the Bureau of Water Supply of New York City. Elihu C. Church, who has charge of the purchasing department of the Board of Water Supply of New York, then discussed the general practice of the board in purchasing. He stated that the fundamental principles underlying purchasing are to get the correct goods in the proper quantities at the right price. He emphasized the need of using goods in rotation; i. e., in the order in which they were purchased, the value of proper storage and periodical inventory. Harrington Emerson then addressed the convention on "Efficiency Management," bringing out those factors with which the water works men were most concerned.

In the morning session of the third day, W. O. Beyer, of Pittsburgh, read a paper on "Turbine-Driven Centrifugal Pumps in Water Works Service," which is given on page 12 of this issue. In the discussion which followed, Mr. Chester, of Pittsburgh, and L. E. Strouthman, of the Allis-Chalmers Company, Milwaukee, questioned the conclusions of the paper on the grounds that, as uniform load conditions are assumed and uniform load conditions are rare in water works service, the turbine-driven pump is not adaptable to water works service. Following Mr. Beyer, Alexander Potter presented a paper on the details of a settling basin he designed for Muskogee, Okla., and M. L. Worrell described two stream crossings made at Rome, Ga. In the afternoon an inspection trip was made to the Crescent Hill filtration plant of the Louisville Water Company.

A session was held Friday morning, when several additional papers were presented and others read by title only. A number of papers prepared for the convention will be found on pages 12 to 32, inclusive, of this issue.

Dow R. Gwinn, president and manager of the Terre Haute (Ind.) Water Company, was elected president. The first to fourth vice-presidents elected were, respectively, Robert J. Thomas, of Lowell, Mass.; John A. Affleck, of Harrisburg, Pa.; George G. Earl, New Orleans, La., and Theodore A. Leisen, of Louisville. All of the officials mentioned were elected without contest, each being advanced one office higher than that held during the past year. Charles B. Henderson, of Davenport, Iowa, was elected fifth vice-president in a vote by the members. John M. Diven, of Troy, N. Y., was re-elected secretary-treasurer. Minneapolis was chosen as the next meeting place of the association.

**The American Road Congress.**

All the efforts that have been made in the last decade to give the United States a system of public roads equal to the one possessed by France will come to a focus in Atlantic City from September 30 to October 5, when the American Road Congress holds its first annual session. The date and place for holding the congress have just been announced by Logan Waller Page, director of the United States Office of Public Roads and active president of the congress.

The American Road Congress will mark the consolidation of the conventions of forty of the most important road organizations in the United States, including the American Assciation for Highway Improvement and the American Automobile Association. Atlantic City has tendered the use of the million-dollar pier for the great gathering, and it is there that the daily sessions will be held. President Taft is honorary president of the congress, which has for its active president Director Page, and for its treasurer, Lee McClung, treasurer of the United States.

The National Association of Road Machinery and Material Manufacturers has voted to hold its exposition of materials and equipment in conjunction with the congress. Among the members of the Manufacturers' Association are many of the largest manufacturing companies in the world. Every industry relating to the building and care of roads and bridges will be represented, and it will be possible for the road builders and road users to acquaint themselves fully with all the labor-saving devices, methods and formulas that American ingenuity and inventive genius have brought out during the past century.

The first two days of the congress will be assigned to the road users, under the auspices of the American Automobile Association; the second two days to the great problems of legislation, finance and economics, under the auspices of the American Association for Highway Improvement; while the last two days will be given up to the engineers, who will discuss problems for construction and maintenance, and to the various associations, which will meet and map out their plans of action, correlate their efforts and make definite arrangements to pull together in the greatest campaign for road improvement and wise, conservative management ever undertaken.

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**The New York Fire Exhibition and International Conference of Fire Prevention.**

Madison Square Garden will be the scene of the first international conference and exhibition, embracing every phase of fire prevention, fire protection and fire fighters, next October, from the 2nd to the 12th.

Fireproof building construction and all accessories, fire alarm systems, automatic sprinklers and fire extinguishers, motor fire apparatus, fire escapes, and, in fact, every device and manufacture in the fields of fire prevention and extinguishment will be exhibited and demonstrated; and, in addition, an important conference will hold sessions daily, providing the first general consideration of the fire question by architects, builders, engineers, insurance men and fire chiefs and fire fighters on the same platform.

The mayors of the principal cities of the United States have already appointed their fire chiefs and commissioners as delegates to attend the conference and exhibition.

The committee of this Fire Conference and Exposition includes Thomas J. Ahearn, New York state fire marshal; Joseph Johnson, New York City fire commissioner; D. E. Wald, representing the American Institute of Architects; Charles H. Cole, fire commissioner, of Boston, Mass.; Chief Charles E. Swingley, of St. Louis, Mo.; Richard H. Johns, president board of fire commisisoners, Baltimore, Md.; Charles F. Seyferlich, Chicago fire marshal; Chief Edward A. Waters, Philadelphia, Pa.; Henry R. Yates, fire chief, Schenectady, N. Y., and secretary New York State Association of Fire Chief Engineers; John Stephen Sewell, late major Engineers of United States army and United States government expert on fire protection; C. A. Palmer, Michigan fire marshal and president Fire Marshals' Association of North America; Felicien Michotte, the French fire protection expert and president and engineer of the Society for the Prevention of Accidents and Fire, of Paris, France. The committee also includes a number of other fire chiefs, insurance officials and fire marshals, with A. D. V. Storey, 1269 Broadway, secretary and general manager.

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**Changes in the Maryland Road Commission.**

Simultaneously with the retirement of Samuel M. Shoemaker, F. G. Hutton and Charles B. Lloyd, from the Maryland road commission, came the resignation of Chief Engineer Walter W. Crosby, making a marked change in the personnel of the state's highway organization. Major Crosby had for some time contemplated resigning, in order to engage in other professional work, and had agreed to remain only until the new members of the commission were appointed by Governor Goldsborough.

Major Crosby is one of the best-known highway engineers in the country, and most of the important road work in Maryland has been done under his direction. He was induced to come to Maryland in January, 1901, by Samuel Shoemaker, who was largely instrumental in having passed the original Baltimore County Roads Law, which provided for a roads engineer for the county. It was the first county in the state to have such an official, and Major Crosby held the office for three years, until 1904.

In 1904 he became general superintendent of the Baltimore system of parks, and held that office for a year, when he was elected chief engineer of the Geological Survey, to which had been intrusted the work of building roads under what is known as the Shoemaker Law, or the State-Aided Roads Act.

When Governor Crothers succeeded in having passed the present State Roads Law, he was chosen the engineer to do the road building, serving both as engineer for the Geological Survey and the State Roads Commission.

Major Crosby will be succeeded by Henry G. Shirley, who has for some time been associated with the Maryland commission.

### Technical Associations.

At the annual meeting of the Milwaukee Engineering Society, held on June 12, Henry Weikel was elected president; Emil A. Vilter, vice-president; Louis E. Bogen, secretary, and M. A. Beck, treasurer.

The annual convention of the Pacific Highway Association will be held August 5, 6 and 7 in Convention Hall of the St. Francis Hotel, San Francisco, Cal. Among the speakers are Governor Hiram Johnson, of California; P. J. Walker, president of the California State Automobile Association; Samuel Hill and Hon. Thomas Taylor, minister of public works, of British Columbia.

At the annual meeting of the New York Electrical Society, held on June 12, Earle L. Ovington presented a paper on "Aeroplane Wireless and the Problem of the Modern Flying Machine."

At the annual meeting of the stockholders of the Cement Products Exhibition Company, held at the offices of the company, 72 West Adams street, Chicago, on May 14, the following officers were elected. President, Edward M. Hagar; vice-president, B. F. Affleck; secretary and treasurer, J. P. Beck.

R. Keith Compton was elected president of the Engineers' Club of Baltimore at the annual meeting on June 6, and George W. Wright was elected vice-president, W. W. Pagon, secretary, and J. F. Apsey, treasurer. The name of the association was changed to the Engineers' Society of Maryland.

At the regular monthly meeting of the American Society of Engineer Draftsmen, held on June 20, William B. Harsel, vice-president, Am. Soc. E. D., read a paper on "Sheet Metal Industries," and Prof. William Noyes, Teachers' College, Columbia University, lectured on "American Woods for Commercial Purposes."

The tentative program for the Los Angeles convention of the National Municipal League, July 8-12, announced by Secretary Woodruff, of Philadelphia, includes discussions on expert city planning, simplicity, publicity and efficiency in municipal affairs, commission form of government, commission government and city planning, municipal finances and taxation, excess condemnation, civil service laws, honesty plus efficiency, state vs. municipal regulation of public utilities, street railway franchises, direct legislation measures, operation of woman's suffrage, home rule in cities, home rule in counties, the boss in politics, socialism in municipalities, commercial value of city planning, housing, municipal help, municipal housekeeping, the proposed new charter for Los Angeles and other matters of like interest to all cities. The officers of the league are: President, William Dudley Foulke, of Indiana; treasurer, George Burnham, Jr.; secretary, Clinton Rogers Woodruff, of Philadelphia.

### W. Rees Jeffreys' Tour for the Third International Road Congress.

W. Rees Jeffreys, secretary of the British Road Board and honorary general secretary of the Third International Road Congress, which will be held at London, England, June, 1913, is visiting this country in the interest of the congress.

On the evening of June 5 he was the guest of honor at a dinner given at the Hotel Astor, New York, by the American Road Builders' Association. About fifty members of that organization were present. The president of the association, Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York, presided.

The chief speech was made by Mr. Jeffreys, who explained his mission to this country. He stated that the meetings of the congress, which will be held in London a year hence, will be particularly useful to Americans interested in similar work, and that the excursions will give an opportunity of becoming familiar with some features of British highways, which are considered superior to anything to be seen elsewhere. He laid particular stress upon the strength of British roads and the organization and methods for maintenance. He is about to make an extended tour of this country and Canada, to give a personal invitation to state, county and municipal officials to send official delegates to London next year, and he will also appear before both committees of Congress, which have practically agreed to recommend an appropriation for membership in the permanent organization in charge of the main business of the International Road Congresses.

While in this country, Mr. Jeffreys will visit Boston, Philadelphia, Baltimore, Washington, Chicago and Detroit. On June 27 he will go to Toronto, Canada, and thence to Niagara, Ottawa, Montreal and Quebec.

### Technical Schools.

Prof. Waldemar Lindgren, chief geologist of the United States Geological Survey, has been appointed head of the department of geology of the Massachusetts Institute of Technology. He succeeds Dr. T. A. Jaggar, Jr., who is to be director of the Hawaiian Volcano Observatory for five years.

Prof. W. C. Hoad, Assoc. M. Am. Soc. C. E., professor of civil engineering at the University of Kansas and engineer of the Kansas State Board of Health, has been

appointed professor of sanitary and municipal engineering at the University of Michigan.

E. S. McCandliss has been appointed instructor in civil engineering at the Missouri School of Mines, Rolla, Mo. Mr. McCandliss is a graduate of Purdue University.

A course in the design of motor trucks has been arranged for the department of mechanical and electrical engineering of Rensselaer Polytechnic Institute. It includes the theory of current practice in design and a laboratory course to study actual performance. An electric motor truck has been installed in one of the laboratories.

"Superheated Steam in Locomotive Service," by W. F. M. Goss, has just been issued as Bulletin No. 57, of the Engineering Experiment Station of the University of Illinois. It presents, in abridged form, the information which originally appeared as Bulletin No. 127, of the Carnegie Institution of Washington.

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**Calendar of Technical Meetings.**

National Municipal League—Annual meeting, Los Angeles, Cal., July 8-12. Clinton Rogers Woodruff, North American Building, Philadelphia, Pa.

International Association of Chiefs of Police—Annual convention, Toronto, Ont., July 9-13. Major Richard Sylvester, superintendent of police, Washington, D. C., president.

Fire Marshals' Association of North America—Annual convention, Hotel Cadillac, Detroit, Mich., July 10-12. State Fire Marshal Palmer, president, Lansing, Mich.

Virginia State Firemen's Association—Twenty-sixth annual convention and tournament, Roanoke, Va., August 28-30. L. E. Lookabill, vice-president, Roanoke, Va.

International Association of Municipal Electricians—Seventeenth annual convention, Peoria, Ill., August 26-30. Clarence R. George, secretary, Houston, Tex.

International Association of Fire Engineers—Annual convention, Denver, Col., September 17-20. James McFall, secretary, Roanoke, Va.

New England Water Works Association—Thirty-first annual convention, Washington, D. C., September 18-19. Willard Kent, secretary. Headquarters, Boston, Mass.

Central States Water Works Association—Sixteenth annual convention, Detroit, Mich., September 24-26. R. P. Bricker, secretary, Shelby Ohio.

New York Fire Exposition and International Conference of Fire Prevention, Protection and Extinguishment—Seventh-first Regiment Armory, New York City, October 2-12. A. D. V. Storey, secretary, 1269 Broadway, New York, N. Y.

American Society of Municipal Improvements—Annual convention, Dallas, Texas, November 12-15. A. Prescott Folwell, secretary, 50 Union Square, New York City.

**Personal Notes.**

Chris P. Jensen has been elected city engineer of Sanger, Cal.

C. E. Phillips has been appointed city engineer of Springfield, Mo.

Manley Osgood has been appointed city engineer of Ann Arbor, Mich. He was formerly assistant city engineer of Lima, Ohio.

The Board of Water Supply of New York City has retained Prof. Arthur H. Blanchard, of Columbia University, as consulting highway engineer.

Rudolph Hering, New York City, has been retained by the board of public works, Los Angeles, Cal., to map out a system of garbage disposal for that city.

John B. Truman, Lafayette, Ind., who has been for the past seven years city engineer of Lafayette, has joined the firm of F. Merten's Sons, of Cumberland, Md.

Walter J. Francis, consulting engineer, of Montreal, Quebec, has been retained by the city of Edmonton, Alta., to prepare plans for proposed water supply extensions.

L. D. Shobe, formerly associated with the Columbia Paving Company, of Columbia, Mo., has resigned to become connected with the special road district at that place.

John I. Riegel has been appointed district engineer of highways for the territory comprising Lackawanna, Wayne, Wyoming, Susquehanna, Pike and Monroe counties in Pennsylvania.

John C. McMynn, A. B., M. M. E., formerly for sixteen years with Robert W. Hunt & Co., has become associated with the Allen Engineering Company, 1233 First National Bank Building, Chicago.

One of the first official acts of C. A. Mullen as street superintendent of Schenectady, N. Y., was to secure an asphalt repair contract for $1.16 per square yard, which is about one dollar a yard cheaper than under former conditions.

George A. O. Ernst, the head of the Boston (Mass.) Bureau of Municipal Research, died on a train near Batavia, N. Y., June 13. He was a lawyer, a graduate of Harvard University and of Harvard Law School. He was sixty-two years of age.

Major W. W. Crosby, consulting engineer, of Baltimore, was given the degree of doctor of science on June 12 by the Maryland Agricultural College, in recognition of his work for the improvement of the highways of the state.

Edward C. Sherman, having completed the designs for the regulating works for the Panama canal, of which he was in charge, has opened an office for the practice of civil engineering at 6 Beacon street, Boston. He will give special attention to hydraulic, sanitary, structural and municipal engineering.

George B. Hull, M. Am. Soc. C. E., assistant engineer, Department of Public Works of Canada, has been appointed district engineer for the Department of Public Works in British Columbia.

# MACHINERY AND TRADE

### An Automatic Water Level Recorder.

A reliable instrument for keeping a continuous record of the water level in a stream has been needed for many years, and the need seems now to be filled by an instrument called the hydro-chronograph. It was invented primarily for stream gaging at isolated points, but many other uses have been found for it, and there are now various designs obtainable for almost any desired duty.

The instrument consists chiefly of a very large recording drum, set with its axis vertical and perfectly balanced for a minimum effort in rotation, moved by clockwork, and a recording pencil moved vertically by a worm and bevel gearing actuated by a float and counterweight acting on a sprocket chain.

The various types cover all ranges of variation in elevation of water surface from 10 to 30 feet, and one design has three sprocket wheels, so that it can be used on streams of various ranges of flood height from 15 to 30 feet. The standard recording drums are designed for a record of a week or a month. One type has two recording pencils and can be used for recording height of both head and tail water, thus giving the effective head directly from the record at any moment.

Floats are designed according to the work to be done, the standards being 3 and 8 inches in diameter. The design of this end of the apparatus is quite important, and several methods of determining the regular fluctuations of the water with as little disturbance from waves as possible are presented.

The instrument is in use by many city water works and water power plants for keeping record of stream and reservoir fluctuations and by the U. S. government and various state departments in their investigations of stream flow, irrigation, water supply and hydraulic problems generally.

Full information concerning the apparatus can be obtained from the Hydro Manufacturing Company, Philadelphia, Pa.

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### Bridge Action of an Unsupported Pavement.

A recent storm in Houston, Tex., made a natural bridge when the water emptying into an excavation made by the gas company for the repairing of a broken main washed out the dirt beneath the street for a distance of 30 square feet, leaving the bitulithic paving laid some three years ago to stand as a natural bridge for the accommodation of the traffic.

The damage done was slight, only in that it necessitated opening the paving for some distance that the men might be able to make the fill. The company experienced some difficulty in making the opening, because of the extreme hardness of the paving. It took two men wielding heavy sledges on a chilled steel cutter in order to make the opening necessary.

The edges of this opening were measured by some interested citizens, who state that there had been no wear in the three years of service given even tho the traffic is extremely heavy.

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### The Atlantic Diaphragm Pumping Engine.

The J. B. McCrary Company, Atlanta, Ga., one of the largest contracting firms in the municipal field in the southeastern states, has stated its entire satisfaction with the Atlantic diaphragm pumping engine. The company purchased one of these outfits early in January, 1912, and since that time it has ordered six additional pumping engines of the same type. Four of these pumps are in use in Atlanta, Ga., and the other three are being moved from place to place on different contracts thruout the south.

W. O. Lumpkin, general superintendent of the company, states that it considers the pumping engine to be a "world beater," and that every outfit has paid for itself several times since it has been put in use.

The engine, which has been described in these pages, is manufactured by the Harold L. Bond Company, 383 M. Atlantic avenue, Boston, Mass.

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### The Anderson Sidewalk Tools.

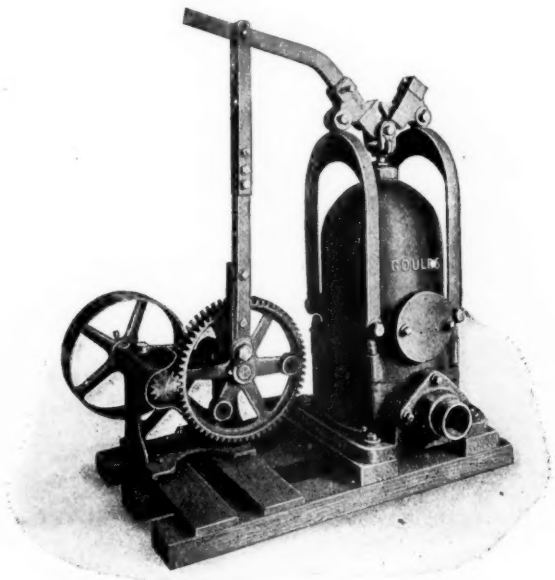
The W. H. Anderson Tool & Supply Company, Detroit, Mich., have placed on the market a line of cement working tools for use in laying artificial stone sidewalks, which are made from their own design. The firm, which has been in business since 1871, has put into their later patterns the results of their former experience. All of their tools are made of a special brass mixture which gives toughness and wearing qualities, and security against corrosion by action of the cement and water.

In their most recent price list a very complete line of tools is shown, not only in the brass, but, for those who desire cheaper tools, the same designs are furnished in iron.

Among the tools of which distinctive designs are shown are the following: Center knives, jointers, round corner smoothing trowels, square corner smoothing trowels, grout cutters, driveway impression frames, gutter templates and sidewalk edgers. In addition to the sidewalk tools mentioned the W. H. Anderson Company furnishes a line of general contractors' tools for all kinds of cement, reinforced concrete and masonry work.

### Adapting Diaphragm Pumps for Power Drive.

The Goulds Manufacturing Company, 131 Falls streets, Seneca Falls, N. Y., has recently developed a power attachment for use in connection with its line of diaphragm pumps. The equipment consists of a jack with pitman for connection to the engine, and a special arm, which is substituted for the hand lever on the pump.



POWER DRIVE FOR DIAPHRAGM PUMP.

The extended end of the pinion shaft on the jack can be equipped with pulley, gear or sprocket as desired for belt, gear or chain connection to the engine. When connected to a gasoline engine or electric motor by means of this jack, the diaphragm pump makes a specially convenient, large capacity outfit for contractors' and builders' service in pumping out excavations.

The equipment is made for adapting any of the Goulds diaphragm pumps for power drive. The illustration shows it as used with the odorless diaphragm force pump.

### The Jeffrey Catalog.

The Jeffrey Manufacturing Co., Columbus, O., has just issued its catalog No. 82, which is a classic as regards the completeness and value of the information contained.

Every kind of elevating and conveying machinery, power transmission machinery and mine equipment is shown in this catalog. The book of itself is a revelation as regards the development of carrying and hoisting machinery, every possible adaptation of such equipment being shown in detail, from the heavier loading and conveying machinery in factories, mines, power plants and lumber yards, to the lighter moving stairways and amusement park "scenic railways" and "figure 8's."

The catalog is of value to the engineer who wishes to adopt the very latest and best design in carirers and conveyors.

### A Felt Paving Joint.

The Philip Carey Company, Lockland, Cincinnati, O., is putting on the market a new sort of paving joint for use in brick, wood block or other streets where an expansion joint is necessary.

The joint is to take the place of tar or asphalt joints, and is said by the company to serve the purpose of these materials at a reduced cost.

Carey's Elastite Paving Joint, as the joint is called, is made of a high-grade felt thoroughly saturated, coated and bonded with a special waterproof asphalt compound, making a compact board which is easily handled. It is made in widths for the thickness of the paving material being used, usually 3½ inches, and is put in as the street is laid. When the street is completed, there is no further trouble and expense of removing the wood strips and filling the cracks left by them with pitch. The thickness varies from ½ inch to one inch, as desired, for wood or brick streets, and for granite streets special joints are made from 5 to 7 inches in width and 1 to 1½ inches in thickness.

# IMPROVEMENT AND CONTRACTING NEWS

## ROADS AND PAVEMENTS.

### BIDS REQUESTED.

Montgomery, Ala.—July 11, 12 m. Surfacing one mile of state aid road with chert. W. S. Keller, state highway engineer.

Hardin, Ill.—July 6, 7 p. m. Constructing 12,000 sq. ft. of granitoid sidewalk. A. D. Campbell, clerk.

Columbus, Ind.—July 5, 10 a. m. Constructing three gravel roads. Philip J. Sater, auditor of Bartholomew county.

Fowler, Ind.—July 8, 11 a. m. Constructing a stone road on the county line between Benton and Newton counties. Lemuel Shipman, auditor.

Frankfort, Ind.—July 6, 2 p. m. Constructing gravel roads in Center, Perry, Ross, Michigan, Warren, Owen, Johnston, and Forest townships and one on line between Kirklin and Sugar Creek townships. Chas. F. Cromwell, auditor.

Goshen, Ind.—July 8, 1:30 p. m. Constructing two highways in Elkhart township. John W. Brown, auditor.

Goshen, Ind.—July 15, 1:30 p. m. Constructing a road in Concord township. John W. Brown, auditor.

Greencastle, Ind.—July 3, 11 a. m. Constructing macadamized road in Greencastle, Washington and Jackson townships. E. L. Airhart, auditor.

Huntington, Ind.—July 8, 10 a. m. Constructing a gravel road in Jefferson townhsip and two gravel roads on line between Jefferson and Lancaster townships. Harold Guthrie, auditor.

Indianapolis, Ind.—July 22, 11 a. m. Constructing a stone road on boundary between Marion and Hendricks counties. W. T. Patton, auditor of Marion county.

Lawrenceburg, Ind.—July 2, 12 m. Constructing a road in Washington township. William F. Fagaly, auditor.

Shelbyville, Ind.—July 2, 7:30 p. m. Lowering grade of portion of Vine street and Morris avenue and constructing sidewalk on Vine street. L. E. Webb, city clerk.

South Bend, Ind.—July 8, 10 a. m. Constructing macadam road between Penn and Center townships. Warren Sedwick, auditor.

Sullivan, Ind.—July 2, 12 m. Constructing stone road in Jackson township. W. F. Bicknell, auditor.

Washington, Ind.—Aug. 6, 2 p. m. Constructing a road between Davies and Greene counties. Lew F. Core, auditor of Daviess county.

Winchester, Ind.—July 3, 11 a. m. Constructing highways in Washington, Greensford, Middle Creek, Stoney Creek, Wayne and Jackson townships, eight roads in all. Henry F. Wood, auditor of Randolph county.

Ft. Dodge, Ia.—July 8. Constructing brick block paving in a number of alleys. W. T. Tang, city clerk.

Marion, Kan.—July 8. Paving 7 blocks with brick, asphalt, asphaltic concrete or concrete. H. A. Rowland, engineer, McPherson, Kan., Mildred Williams, city clerk.

Vicksburg, Miss.—July 11. Constructing 1,600,000 yds. of earth work on government district. J. A. Woodruff, major of engineers.

Cincinnati, O.—July 5, 12 m. Repaving the Duck Creek road under specification No. 339. Certified check $500. Albert Reinhardt, clerk, board of Hamilton county commissioners.

Cincinnati, O.—July 12, 12 m. Oiling the Cleves Miamitown road under specification No. 358. Certified check $500. Albert Reinhardt, clerk board of Hamilton county commissioners.

Cleveland, O.—July 3. Paving 37 sections of street with brick. W. J. Springborn, director of public service. W. K. Kirby, secretary.

Cleveland, O.—July 5, 12 m. Paving Hower avenue by the city of Cleveland and of East Cleveland, with brick. W. J. Springborn, director of public service, Cleveland, O.; J. A. Fogle, director of public service, East Cleveland, O.

Elyria, O.—July 2, 12 m. Paving construction as follows: Seventh street with brick, sheet asphalt or block asphalt, certified check, $500; East River street, 1st section with brick, grout filled, and 2nd section with brick sand filled, certified check, $500; Broad street with brick; Harrison street with brick or sheet asphalt, certified check, $500. E. H. Lewis, director of public service.

Grandview Heights, O.—July 16, 12 m. Constructing bituminous macadam roadway on Bluff avenue, Glenn avenue, Elmwood avenue and Dale avenue. Certified check, $5,000. John Hinterschied, village clerk.

Lisbon, O.—July 3, 10 a. m. Paving the Salem-Ellsworth road with brick, under state highway G. petition No. 379. Length 5,280 ft., width 10 to 14 ft. Certified check, $300. James R. Marker, Columbus, O., state highway commissioner. Commissioners of Columbiana county, Lisbon, O.

Harrisburg, Pa.—July 9, 10 a. m. Road construction as follows: Reconstructing 10,115 ft. of asphaltic macadam road, 16 ft. wide, in Bucks county, certified check $1,500; reconstructing 49,394 ft. of macadam road, repair in Blair county, certified check $1,000; reconstructing 8,354 lin. ft. of asphalt macadam road, penetration method, 16 ft. wide, Berks county, certified check $1,500; reconstructing 16,300 lin. ft. of asphaltic concrete road, 16 ft. wide, in Lehigh county, certified check $2,000; reconstructing 40,143 ft. of asphaltic macadam road, 16 ft., in Northumberland county, certified check $5,000; reconstructing 8,048 lin. ft. of asphaltic macadam road, 16 ft. wide, in Bucks county, certified check $1,500; reconstructing 13,735 ft. of asphaltic macadam road, penetration method, 16 ft. wide, in Jefferson county, certified check $2,000; reconstructing 3,760 lin. ft. of brick paving, 16 ft. wide, in Chelleroi borough, certified check $1,000; reconstructing 14,807 ft. penetration method, 16 ft. wide, certified check $2,000, in Mercer county; reconstructing 10,756 ft. of asphalt macadam, penetration method, 16 ft. wide, on route No. 57, certified check $1,500; reconstructing 9,632 ft. of asphalt macadam, penetration method, 16 ft. wide, in Mercer county, certified check $1,500; reconstructing 18,843 ft. of asphalt macadam, penetration method, 16 ft.

wide, in Delaware county, certified check $2,000. Edward M. Bigelow, state highway commissioner.

Pittsburgh, Pa.—July 16, 10 a. m. Constructing the following roads: Bakerstown and Culmerville road, 6 miles, certified check, $2,000; West Run road, 4.1 miles, certified check, $2,000; Spring Run road, 1.6 miles, certified check, $1,000; Center road, an extension, 0.7 mile, certified check, $1,000. R. J. Cunningham, county controller.

Washington, Pa.—July 6, 1 p. m. Paving Wylie avenue with brick. Certified check, $500. James B. Wylie, chairman, supervisors of Canton township.

Huntington, W. Va.—July 22, 12 m. Constructing 3 blocks of brick streets and 27 blocks of brick alleys. Certified check, $500 on each bid. L. A. Pollock, commissioner of streets; A. B. Maupin, city engineer.

Edgerton, Wis.—July 15, 10 a. m. Improving Fulton street with an asphalt macadam pavement, with concrete curb and gutter. H. B. Knapp, city clerk.

Janesville, Wis.—July 11, 2 p. m. Constructing 175 sq. yds. of brick paving along alleys in oes subdivision. James A. Fathers, chairman board of public works.

## CONTRACTS AWARDED.

Little Rock, Ark.—Paving Louisiana street with creosoted wood block, to E. J. Watterstrom, $96,345. The district includes 38,600 sq. yds. Southern yellow pine will be used.

Hartford, Conn.—The following state highway contracts have been awarded: 17,083 ft. of gravel road, to B. Terini, Ashland, Mass.; 5,977 ft. of Telford macadam, to A. Brozos & Son, Middletown, N. Y.; 2,789 ft. of gravel to W. C. Wilcox; 4,950 ft. of gravel, to A. E. Douglas, Glastonbury, Conn.; 11,600 ft. of gravel, to the Jones & Corcaro Construction Co., Willimantic, Conn.; 4,100 ft. of macadam, to A. Brozos & Son, Middletown, N. Y.; 4,129 ft. of macadam, to Olmstead & Olmstead, Hartford, Conn.; 1,245 ft. of macadam, to Jones & Corcaro Construction Co.; 18,652 ft. of gravel, to C. W. Tryon, Meriden, Conn.

Waynesboro, Ga.—Constructing 8 miles of cement sidewalk, to A. H. McDaniel, Augusta, Ga.

Boise, Ida.—Constructing 2 miles of concrete roadway, to the Inland Empire Hassam Paving Company, about $25,000.

Elgin, Ill.—Paving South State street, to Logan & Pierce, Elgin, Ill., about $35,000.

Rochelle, Ill.—Paving a number of streets, to Arthur E. Rutledge, Rockford, Ill., $77,197.

Peoria, Ill.—Paving in the Broadway paving district, to Jansen & Zoeller, Pekin, Ill.

Peoria, Ill.—Paving Ravine avenue with asphalt, to John W. Bushell, $9,255; paving Ravine avenue, second section, to the same, $1,872.

Jasper, Ind.—Constructing gravel roads in Patoka and Bainbridge townships, to Traylor & Kremp, Jasper, Ind., $14,600.

Marion, Ind.—The following road contracts have been awarded: Road to Knotts & McDerman, $10,347; Reed road, to William Yates, $1,838; Dubois road, to John W. Slater, $10,400; Emerick road, to John W. Slater, $16,180; the Whitlock road, to Knotts & McDerman, $7,403; the Parcoast road, to Miles Shaffer, $13,440.

Portland, Ind.—Constructing 3 miles of gravel road in Jackson township, to F. J. Wright, $7,848.

Terre Haute, Ind.—The following gravel road contracts: Stroie road, to Thomas Ferguson and Lon Lee, $5,500; Hanker road, to James McGuire & Sons, Brazil, Ind., $10,763; the Rigney road, to Thomas Ferguson and Lon Lee, $3,100.

Valparaiso, Ind.—Constructing a road in Pine township, to Ray Demass, Chesterton, Ind., $12,000.

Des Moines, Ia.—Constructing 37,000 yds. of bithulithic paving, to James Horrabin Co., at $1.95 per sq. yds. Total cost $62,140.

Des Moines, Ia.—Paving Woodland avenue and Forty-fourth street, to the Des Moines Asphalt Paving Co., Des Moines, Ia.

Des Moines, Ia.—Paving Grand avenue with concrete, to Lytton & Rankin Construction Company; paving Eighth street with brick, to the J. W. Turner Improvement Co.

Fort Dodge, Ia.—Constructing 50,000 sq. ft. of sidewalk, to J. A. Conway, Fort Dodge, Ia., at 8.84c a sq. ft.

Greenfield, Ia.—Constructing 14,860 sq. yds. of concrete paving, to D. W. Wright & Co., Bedford, Ia., $24,722. Iowa Engineering Co., Clinton, Ia., engineers.

Greenfield, Ia.—Constructing ten blocks of concrete paving, to E. W. Wright & Co., Bedford, Ia.

Grundy Center, Ia.—Constructing 18 blocks of concrete paving, to the Dearborn Construction Co., Waterloo, Ia., $1.17 per sq. yd.

Iowa Falls, Ia.—The contract for 30,000 yds. of pavement which was awarded to Camery & Co., Harlan, Ia., has been sub-let to the Dearborn Contracting Co., Waterloo, Iowa.

Iowa Falls, Ia.—Constructing 30,000 sq. yds. of concrete paving, to M. A. Camery & Co., Harlan, Ia.

Iowa Falls, Ia.—Constructing 30,000 yds. of concrete paving, to M. A. Camery & Co., Harlan, Ia.

Vinton, Ia.—Paving Washington street with brick, to Loomis Bros., Cedar Rapids, Iowa.

Waverly, Ia.—Paving 35,000 sq. yds. with brick block, to the Ford Paving Co., Cedar Rapids, Ia., $1.69 per sq. yd.

Winterset, Ia.—Paving 28 blocks with asphalt, to R. A. Elzy, Marshalltown, Ia., at $1.71 per sq. yd.

Baltimore, Md.—Paving the Fallsway, to the D. M. Andrews Paving Co., $74,000.

Boston, Mass.—The following paving contracts have been awarded: Constructing bitulithic pavement on River street, to Warren Bros. Co., $4,038; constructing sidewalks and grading, to John McCourt Co., $1,571; constructing tar macadam roadway on Stuart street, to J. T. Coleman & Sons, $1,264; constructing wood block pavement, Washington street, to William J. Barry, $105,299.

Alma, Mich.—Constructing 15,000 sq. yds. of concrete pavement, to the Markle Cement & Coal Co., about $40,000.

Hamtramck, Mich.—Paving Smith and Clay avenues and Dubois street, to R. D. Baker, about $14,000; paving Florian avenue, to R. D. Baker, $5,500.

Hillsdale, Mich.—Paving Broad street, to Carpenter & Anderson, Grand Rapids, Mich., $17,324.

Hillsdale, Mich.—Constructing $18,000 worth of new pavement, to Carpenter & Anderson, Grand Rapids, Mich.

Manistique, Mich.—Constructing 5 miles of state aid macadamized road, to the Delta Contracting Co., Escanaba, Mich., $25,600.

Marquette, Mich.—Constructing 5 miles of state road, to the Delta Contracting Co., Escanaba, Mich., $25,600.

Saginaw, Mich.—The following paving contracts have been awarded for 1912: All asphalt paving, to F. F. Saxton; all brick paving with stone curb, to G. & J. Lalonde; all brick paving with cement curb, to W. M. Sager.

Aurora, Minn.—Constructing 4 miles of road, to Andrew Thompson, at $915 per mile.

South St. Paul, Minn.—Paving Concord street and Grand avenue, to Fielding & Shepley, St. Paul, Minn., $16,374.

Albany, N. Y.—The following road contracts have been awarded by the state highway commission: Slingerlands to Albany, 4.23 miles, to J. & T. Murphy, Cobleskill, at $52,515; Watervliet city, Nineteenth street, 0.46 mile, Thomas H. Karr, Troy, $12,788; Cohoes city, Columbia street, 0.43 mile, Thomas H. Karr, Troy, $6,009; De Freestville, south, 0.67 mile, Arnold & Shearer, Albany, $8,061; Troy city-Brunswick turnpike, 0.95 mile, Corliss Construction Co., Troy,

$15,900; Troy city-Oil Mill hill, 1.58 miles, County Construction Co., Troy, $19,163; West Sand Lake-Averill Park, 3.66 miles, Marin Murray Co., Troy, $38,476; Central Bridge-Quaker street, 4.16 miles, Ruddy & Saunders Construction Co., Troy, $38,316; Cairo-Windham, 3.39 miles, Catskill Construction Co., Catskill, $38,454; Coxsackie-Ravena, 4.62 miles, Griswold & Malloy, Mechanicville, $48,853; Hunter-Jewett Center, 6.13 miles, Thomas H. Gill Co., Binghamton, $88,588; Piseco-Lake Pleasant, 7.92 miles, Creeden & Pitou, New York city, $109,669; Kelsey Corners-W. Exeter, 6.38 miles, Harry W. Roberts Co., Utica, $59,185; Collins-Maryland, 5.69 miles, L. L. Melius Co., New York city, $49,849; Schuylerville village, 1.05 miles, Lang & Norton, Schuylerville, $28,919; Ballston-High Mills, 1.77 miles, H. L. Baker, Cambridge Mass., $15,282; Elizabethtown-Keene, 6.21 miles, Beebe Bros., Keene Valley, $91,809; Upper Jay-Keene, 6.06 miles, Flood & Van Wirt Co., Hudson Falls, $91,-346; Fort Plain-Hessville, 6.20 miles, Union Paving Co., Schenectady, $92,802; Schenevus-Schoharie county line, 12.20 miles, L. L. Melius, New York city, $110,886; Chatham Center-Rider Mills, 6.71 miles, L. L. Melius, New York city, $73,166; Jay-Upper Jay, 5.69 miles, Boynton & McNally, Keeseville, $50,-719; Elizabethtown-Keene, 6.18 miles, Boynton & McNally, Keeseville, $84,301; Stillwater-Schuylerville, 7.52 miles, Lang & Norton, Schuylerville, $76,186; Esperance-Esperance Station, 1.37 miles, J. J. Malloy, Schenectady, $14,107, and Warrensburg-Thurman Station, 3.52 miles, Joseph Walker Construction Co., Albany, 35,776.

Brooklyn, N. Y.—Constructing 12 highway and sewer contracts in the borough of Queens, to Hicks-Johnson Contracting Co., $187,288.

Fulton, N. Y.—Paving West Broadway, to W. J. Harnett, Fulton, N. Y., $27,955.

Niagara Falls, N. Y.—Furnishing 750,000 asphalt blocks to the Newcastle Asphalt Block Co., Newcastle, Pa.

Columbus, O.—Constructing an experimental stretch of road for the state of Ohio, to Thomas J. McKim, Lawrenceburg, Ind., $80,-000.

Hamilton, O.—Constructing 4.15 miles of macadamized road on the Middletown road, to the Garver Construction Co., $25,250.

Warren, O.—Constructing 2.69 miles of the Hartford-Northern road, to Findlay, Ward & Co., Sharpsville, Pa., $18,400.

Youngstown, O.—The following paving contracts have been awarded: Garfield avenue, $23,945, and Worthington, $10,847, to Fleming & Platt; Darrow street, T. & P. J. Grady, $4,113; Hughes and Olivet court, $6,663, and Homer avenue, $9,203, to Miller Bros.

Youngstown, O.—Macadamizing 1.5 miles of road west of the village of Canfield, to I. W. Coy, Calla, O., $11,903.

Hamilton, O.—Constructing 4.15 miles of macadamized pike on the Middletown road, to the Garver Construction Co., $25,250.

Aliquippa, Pa.—Paving Erie avenue for a distance of 2 blocks, to S. B. Markley, Woodlawn, Pa., $10,497. The bid of Freshwater Bros., of Chester, W. Va., was rejected for the reason that they did not comply with the specifications.

Connellsville, Pa.—Constructing 6,300 ft. of brick road in German township, to John G. Hoover, Uniontown, Pa., $35,000.

Easton, Pa.—The following paving coning contracts have been awarded: 225 ft. of granolithic sidewalks, to Mucci & Miller, $134; furnishing 389,000 vitrified blocks, to the American Sewer Pipe Co., New Cumberland, W. Va., $23.64 per thousand; furnishing 40,700 hillside paving blocks, to the same, $24 per thousand; repaving North Hampton street, to Frank McInerney; paving Bank street with vitrified brick, to the Miles-Tighe Contracting Co.; paving Dock street with vitrified brick, to Frank McInerney.

Harrisburg, Pa.—Constructing a section of the national road near Claysville, to R. B. Taylor, Bellefonte, Pa., $98,337.

Hazleton, Pa.—The following paving contracts have been awarded: North Pine street, to Ario Ruth, $8,892; Diamond avenue, to Crolomo Tecemo, $26,166.

Verona, Pa.—Constructing block pavement on Wildwood avenue, to J. B. Sheets & Co., Pittsburgh, Pa., about $16,000.

Logan, Utah.—Constructing 12 miles of road, to James E. Wilson, Jr., $9,541.

Aberdeen, Wash.—Paving Broadway for a distance of 7,750 yds., to Barber Asphalt Paving Co., $13,000. Chas. Ewart, city engineer.

Everett, Wash.—Paving Pine street, to Welsh & Christenson Construction Co., Everett, Wash., $11,152.

Kent, Wash.—Paving 9 blocks with Dolarway, to the American Contracting Co., Seattle, Wash., $18,415.

Seattle, Wash.—Paving Genesee street, to Geo. C. Dietrich, Globe Bldg., Seattle, Wash., $62,670.

Tacoma, Wash.—Constructing a boulevard thru South Tacoma, to the Washington Paving Co., $88,447.

## CONTEMPLATED WORK.

Concord, Cal.—The macadamizing of several streets to cost about $50,000 is contemplated.

Lordsburg, Cal.—A $36,000 bond issue for road construction has been voted.

Hartford, Conn.—James H. MacDonald, state highway commissioner, has decided to advertise for bids for state road work as follows: Chatham, 15,783 ft. of grading and 6,080 ft. of macadam; Wilton, 8,500 ft. of gravel; Monroe, 7,650 ft. of gravel; Canterbury, 2,000 ft. of gravel; Naugatuck, 4,000 ft. of gravel; Winchester, 3,250 ft. of macadam.

Fitzgerald, Ga.—A $120,000 bond issue for paving streets has been voted.

Des Moines, Ia.—Horace Susong, city clerk, has been instructed to advertise for bids for a creosoted wood block pavement on Grand avenue bridge.

Des Moines, Ia.—The paving of University avenue with bitulithic, about 40,000 sq. yds., is contemplated.

Effingham, Ill.—A $35,000 bond issue for the construction of macadam road has been voted.

Moline, Ill.—The paving of Second avenue in East Moline with asphalt, to cost about $36,400, is contemplated.

Oakland, Ill.—Extensive street improvements have been ordered by the city council. C. L. James, Mattoon, Ill., is city engineer.

Pontiac, Ill.—The city will pave 32 blocks of street with brick and 5 blocks with creosoted wood block during this summer. T. C. Knight, city engineer.

Rockford, Ill.—Paving Harlem avenue and Main street with brick at an estimated cost of $71,047 is contemplated. City Engineer Main.

Logansport, Ind.—A $13,000 appropriation has been made for paving Burlington avenue and Fifth street.

Baltimore, Md.—The following paving work is contemplated by the paving commission: Grady street, with vitrified brick; Exeter street, with granite block; Front street, with vitrified block; Castle street, bituminous concrete; Richmond street, with bituminous concrete; Low street, with vitrified block.

Minneapolis, Minn.—The county commissioners have appropriated $10,000 to pave one mile of Superior boulevard with concrete.

Jackson, Miss.—Hinds county has voted a $100,000 bond issue for road construction.

Meridian, Miss.—A $100,000 bond issue for street improvement has been voted. C. W. O'Leary, city clerk.

Camden, N. J.—The street committee has decided to advertise for bids for the con-

struction of an asphalt plant for the city, to cost about $15,000.

Bath, N. Y.—A $30,000 bond issue has been voted for the paving of Liberty, Steuben, West Morris and West Washington avenues.

Canisteo, N. Y.—An $18,000 bond issue for road construction has been voted.

Jamestown, N. Y.—The city council has voted to pave Prendergast avenue with asphalt block at a cost of $42,000.

Watertown, N. Y.—A $110,000 bond issue for paving construction has been voted.

Canton, O.—City Engineer Weber has prepared plans for the paving of Dueber avenue, to cost $34,000.

Youngstown, O.—Poland township has voted a $15,000 bond issue for road construction.

Beallsville, Pa.—The borough of Deemston, Pa., has voted a $10,000 bond issue for paving improvement.

Claysville, Pa.—A $12,000 bond issue has been voted for street improvement. C. S. Miller, borough clerk.

Collingswood, Pa.—Arrangements are being made for constructing street pavements, to cost about $50,000.

Houston, Pa.—A $20,000 bond issue for street improvement has been voted. J. S. Gantz, borough secretary.

Lansdowne, Pa.—A $68,500 bond issue has been voted for highway and sewer improvement. John W. Davis, borough secretary.

Uniontown, Pa.—About $78,000 will be spent in road improvements in Fayette county this summer. H. B. Stevens, division superintendent of the state highway department.

Greenville, S. C.—Bids will be requested immediately for the paving of Augusta, Pendleton, East Washington and Buncombe streets. B. T. Ballenger, city engineer.

Bastrop, Tex.—An $80,000 bond issue for road construction has been voted by the precinct number one.

Ennis, Tex.—A $55,000 bond issue has been voted by the Palmer road district for the construction of roads.

Franklin, Tex.—Robertson county has voted a $100,000 bond issue for road construction.

Franklin, Tex.—A $100,000 bond issue for permanent road construction has been voted.

Marshall, Tex.—A $28,000 bond issue for street improvement has been voted. H. S. Rice, city secretary.

Orange, Va.—A $125,000 for road construction has been voted by the Barbour and Taylor district of Orange county.

Fairmont, W. Va.—A $300,000 bond issue for paving ten miles of road has been voted by Mannington district.

Hurley, Wis.—Iron county has voted a $35,000 bond issue for road construction.

## SEWERS.

### BIDS REQUESTED.

Hartford, Conn.—July 9, 11 a. m. Furnishing and erecting equipment for the East Side sewage pumping station. Certified check, $1,000. Joseph Buths, secretary, board of contract and supply.

McPherson, Kan.—July 12. Constructing 6.75 miles of 8, 10 and 12 and 15-inch sewers. H. A. Rowland, city engineer.

New Orleans, Ia.—Aug. 1, 12 m. Constructing a reinforced concrete siphon under the new basin navigation canal at Broad street, under contract No. 45 D. George G. Earl, superintendent. F. S. Shield, secretary.

Albert Lea, Minn.—July 3, 7:30 p. m. Constructing the following sewers: 1,319 ft. of 6-in., 4,278 ft. of 8-in., 2,697 ft. of 10-in. sanitary sewers, 48 manholes, 1 ejector for 16-ft. well, 1 ejector for 22-ft. well, 2 100-gal. capacity air lift ejectors, 1 air compressor and 1 air reservoir. Certified check, 10 per cent. T. J. Dudley, city clerk.

Chinook, Mont.—July 6. Constructing complete sewerage system to cost $30,000. L. C. Smith, city engineer.

Cambridge, O.—July 6, 12 m. Constructing sanitary sewers and appurtenances on South Ninth street, Campbell avenue, Woodlawn and East Beatty street, 4,600 ft. in all. Certified check 10 per cent. J. M. Logan, director of public service.

Hastings, Pa.—July 11, 8:30 p. m. Constructing 14,000 ft. of sewers. C. F. Hoyt, borough clerk; Chas. E. Schlicher, Spangler, Pa., engineer.

### CONTRACTS AWARDED.

Mobile, Ala.—Constructing sanitary sewer extensions to Sullivan, Long and Hagerty, $49,905.

Texarkana, Ark.-Tex.—Constructing sewer in district number 17, to Geo. Conway, $17,000.

Santa Barbara, Cal.—Constructing the Santa Maria sewer system, to Miatenovich & Dilcie, Los Angeles, Cal., $28,986.

Lakeland, Fla.—Constructing 25 miles of sanitary sewer, to J. W. Gurley & Co., Mobile, Ala., about $75,000.

Charles City, Ia.—Constructing 2 miles of sewer, to C. B. McNamara Contracting Co., Dubuque, Ia.

Creston, Ia.—Constructing the Sycamore street pipe sewer, to W. L. Thomas, Corning, Ia., $2,009. Theo. F. Delay, city engineer.

Iowa City, Ia.—Constructing the East End sewer system, to William Harrabin, Iowa City, Ia., $16,184. James W. Berry, city engineer.

Iowa City, Ia.—Constructing sewer on LaFayette street, to Hoar & Parkison. James W. Barry, engineer.

lands Co., Cornelius J. Ton, president, has awarded a contract to Irwin D. Groak, Monadnock bldg., Chicago, for a drainage pumping plant, including three 50-horsepower Olds engines and three American Well Works, centrifugal pumps, with a total capacity of 104,000,000 gallons in 24 hours. The Allen Engineering Co., First National Bank bldg., Chicago, Ill., engineers.

Keokuk, Ia.—Frank L. Griffey and Co., a new firm, were low bidders for four blocks of sanitary sewers.

Sandwich, Ill.—Constructing sewerage system and sewage disposal plant, to the E. R. Harding Co., Racine, Wis., $38,301.

Boston, Mass.—Constructing sewers in Dartmouth and Stuart streets, to Andrew & Cusack, $7,696.

Wilmar, Minn.—Constructing complete sanitary sewer system, to W. B. Bosworth, Ada, Minn., $27,500.

North Tonawanda, N. Y.—Constructing several miles of sewers, to the Frontier Contracting Co., Buffalo, N. Y., $5,442.

Syracuse, N. Y.—Constructing the Harbor Brook intercepting sewers, to the Marnell Co., $20,886.

Columbus, O.—Constructing the West Side storm sewer, to D. E. Sullivan & Son, about $60,000; constructing the Medill avenue and Twentieth street sewers, to A. G. Hunt, $22,000.

Columbus, O.—Constructing sewer to cost about $82,000, to D. E. Sullivan & Son, A. D. Hunt.

Dallas, Ore.—Constructing sanitary sewer system, to Dennis & Christensen, McMinnville, Ore., about $20,000.

Lock Haven, Pa.—Constructing sewer in village of Johnston Creek, to Frank P. Mansfield, about $6,000.

Dallas, Tex.—Constructing storm sewer on Exposition and Parry avenues, to the Dallas Lime & Gravel Co.

Chicago, Ill.—The New Orleans Nether-

Norfolk, Va.—Constructing sewer, to Geo. M. Guild & Co., Chattanooga, Tenn., $200,000.

Walla Walla, Wash.—Laying 6-inch lateral sewer on Maple street, to the T. H. Sutherland Co.

Ashland, Wis.—Constructing sewerage sys-

tem east of Bay City creek, to E. R. Harder & Co., Racine, Wis.

Winnipeg, Man., Canada.—Constructing trunk sewer on Dawson street, to Van Hornbeck & Co., $147,651.

CONTEMPLATED WORK.

Sisson, Cal.—A $40,000 bond issue for the construction of a sewerage system and the building of a city hall has been voted.

Apalachicola, Fla.—A $15,000 bond issue for extension of the sewerage system has been voted. C. R. Harris, city engineer.

Burley, Ida.—An $85,000 bond issue has been voted for a water and sewerage system and extending the electric lighting and heating system.

Holstein, Ia.—A $17,000 bond issue for the construction of a sanitary sewerage system has been voted.

Mansfield, La.—Estimates have been prepared for water works extensions to cost $56,000 and a sewerage system to cost $38,000.

Flint, Mich.—Henry E. Riggs, Ann Arbor, Mich., has been retained to prepare plans and estimates for the construction of a sewer system to cost about $50,000.

Howell, Mich.—A $48,000 bond issue for sewer construction has been voted.

Kenmore, O.—The Payne Engineering Co., of Akron, O., has been retained to make plans and recommendations for a sewage disposal plant.

Meridian, Miss.—A $20,000 bond issue for sewer improvement has been voted. C. W. O'Leary, city clerk.

Lestershire, N. Y.—A $14,000 bond issue for sewer construction has been voted.

Saranac Lake, N. Y.—A $50,000 bond issue for sewer construction has been voted. Seaver A. Miller, village clerk.

Celina, O.—An $80,000 bond issue for sewer improvement has been voted. James H. Carlin, village clerk.

Cleveland, O.—The state board of health will, in the near future, instruct the city to issue $2,000,000 in bonds to construct a sewage disposal plant.

Coatesville, Pa.—Alexander Potter, 114 Liberty street, New York City, has been retained to prepare plans and estimates for a sewage disposal plant.

Dallas, Tex.—Bids will be opened about July 24, for the construction of a sewage disposal plant. James H. Fuertes, consulting engineer, New York, N. Y.

Bellingham, Wash.—W. H. North, city engineer, has prepared plans and estimates for construction of sewers in various streets, to cost about $5,000.

Warwood, W. Va.—A $15,000 bond issue for sewer construction has been voted. Charles B. Miller, city recorder.

## WATER WORKS.

CONTRACTS AWARDED.

Oakland, Cal.—Constructing auxiliary steel pressure line in Fourteenth street, to William Heasey, $11,455.

Milliken, Colo.—Constructing water works system complete, to G. A. Smith, Denver, Colo., $13,000.

Burr Oak, Kan.—Constructing municipal water works system, to Des Moines Bridge & Iron Co.

Bolivar, Mo.—Extending water works system and constructing an electric light plant, to the Commercial Construction Co., Kansas City, Mo., $15,750.

Louisville, Neb.—Constructing a water works plant, to the Alamo Engine & Supply Co., Omaha, Neb.

Findlay, O.—Furnishing a 3,000,000-gal. pumping engine for the Riverside Park pumping station, to the Canton-Hughes Pump Co., Wooster, O.

Navarre, O.—The following contracts have been awarded for the construction of the $25,000 water works system: Laying pipe, to John Sorenson & Son, Ravenna, O.; furnishing tank and tower, to the Des Moines Bridge & Iron Co., Des Moines, Ia.; furnishing pipe, to the United States Cast Iron Pipe Co., Pittsburgh, Pa.; furnishing valves and hydrants, to the Kennedy Valve Mfg. Co., Elyria, O.; constructing pumping station, to Silas Engleman, Navarre, O. The pump contracts have not yet been awarded.

Norwalk, O.—Furnishing pipe for water main extension, to the Massillon Iron & Steel Co., Massillon, O.

Holdenville, Okla.—The following water works contracts have been awarded: Constructing power house and reservoir, to Brittain & Dotaw, $1,650; constructing pipe line, pump house and pit in river, to the J. S. Ferry Construction Co., $4,459; furnishing 500,000 gallon filter plant, to the Pittsburgh Filter Mfg. Co., Pittsburgh, Pa., $6,698.

Erie, Pa.—Improving water works system, to Henry Shenk Co., Erie, Pa.

Syracuse, N. Y.—Furnishing the following water works equipment: Curb boxes, to W P. Taylor Co.; furnishing corporation cocks, to Pratt, Cody & Co.; furnishing 50,000 lbs. of lead pipe and 25,000 lbs. of soft pig lead, to Pierce, Butler & Pierce Co.

Tarentum, Pa.—Constructing a municipal water works system, to J. I. Dick, Tarentum, Pa., $60,133.

Spokane, Wash.—Constructing water main extensions in Manito Heights, to A. Wold, $9,750.

CONTEMPLATED WORK.

Redlands, Cal.—A $600,000 bond issue for the purchase of the water works system has been voted by the municipality.

Redlands, Cal.—A $600,000 bond issue for water works construction has been voted. R. Warner Thomas, city clerk.

Johnstown, Colo.—A $20,000 bond issue for water works construction has been voted. J. F. Thomas, city clerk.

Montrose, Colo.—The city engineer has been instructed to prepare plans and specifications for enlarging the water works system at an estimated cost of about $70,000.

Jesup, Ga.—A $35,000 bond issue for water works construction has been voted.

Burley, Ida.—An $85,000 bond issue for a water and sewerage system and extending the electric lighting and heating system has been voted.

Ashton, Ill.—The installation of a complete water works system is contemplated.

Greenfield, Ind.—The village has voted in favor of constructing a water works system.

Dunlap, Ia.—An $8,000 bond issue for water works construction has been voted. R. W. Wettengel, city clerk.

Logan, Ia.—A $20,000 bond issue for the construction of a water works system has been voted.

Storm Lake, Ia.—A $15,000 bond issue has been voted for extending the water works system and installing a complete filtration plant.

Mansfield, La.—Estimates have been prepared for water works extensions to cost $56,000 and a sewerage system, $38,000.

Highland Park, Mich.—A $49,500 bond issue for water works extensions has been voted.

Stockbridge, Mich.—A $20,000 bond issue for the installation of a water works system has been voted.

Meridian, Miss.—A $170,000 bond issue for water works improvement has been voted. C. W. O'Leary, city clerk.

College View, Neb.—The village has voted a $25,000 bond issue for the installation of a water works system.

Dewitt, Neb.—A $21,500 bond issue for water works construction has been voted.

Albion, N. Y.—A $130,000 bond issue for

water works construction has been voted. E. S. Eaton, village clerk.

Newburg, N. Y.—A $75,000 bond issue for water works improvement has been voted.

Oneida, N. Y.—A $7,000 bond issue for water main construction has been voted. O. J. Covell, city clerk.

Akron, O.—A $1,250,000 bond issue for water works improvement has been voted.

Gresham, Ore.—A $5,000 bond issue has been voted for water works construction.

Natrona, Pa.—Natrona Water Company will at once extend water mains 2,000 to 3,000 ft.

Blackville, S. C.—J. M. Johnston, Florence, S. C., has been retained to supervise the construction of a city water works system, and a sewerage system.

Mount Vernon, Tex.—A $20,000 bond issue for water works construction has been approved by the acting attorney general.

## BRIDGES.

### BIDS REQUESTED.

Aurora, Ind.—July 2. Constructing the following bridges: Salt Fork bridge; the Cold Springs bridge; the Rumsey Ford bridge; the Asche bridge and the Pike creek bridge. W. Magaly, auditor of Dearborn county.

Greencastle, Ind.—July 29, 11 a. m. Constructing two bridges in Washington township. E. L. Airhart, auditor.

Corydon, Ind.—July 2, 2 p. m. Constructing steel bridge at Milltown, between Harrison and Crawford counties. William Taylor, auditor of Harrison county.

Valley Falls, Kan.—July 15, 12 m. Constructing two reinforced concrete bridges, costing about $1,000, and one reinforced concrete bridge, costing $230. Dwight A. Bliss, county clerk.

Vicksburg, Miss.—July 3. Constructing steel bridge over Ball Ground creek in 5th district. J. B. Laughlin, city clerk.

Sidney, Nebr.—July 8. Constructing complete four steel beam bridges. H. P. Doran, county clerk.

Washburn, N. D.—July 8.—Constructing a steel I beam or truss bridge. Certified check 5 per cent. D. C. Wright, chairman of county board; T. E. Thompson, county auditor.

Cincinnati, O.—July 12, 12 m. Constructing a concrete box culvert, under specification No. 351. Certified check $500. Albert Reinhardt, clerk, board of Hamilton county commissioners.

Cleveland, O.—July 3. Constructing a concrete bridge on the Solon road under report No. 2952. Certified check 10 per cent. John F. Goldenbogen, clerk of Cuyahoga county.

Cleveland, O.—July 20, 11 a. m. Constructing concrete bridge on Drake road under Report No. 2945. John F. Goldenbogen, clerk of Cuyahoga county.

Columbus, O.—July 5, 12 m. Construction work as follows: Estimate No. 397, constructing reinforced concrete bridge on King avenue; estimate No. 398, constructing limestone rip-rap on King avenue; estimate No. 399, constructing west abutment of bridge on the Worthington and Elmwood avenue. Certified checks as follows: Estimate No. 397, $1,000; estimate Nos. 398 and 399, $200 each. F. M. Savre, county auditor.

Morristown, Pa.—July 8. Constructing county bridge over Tacony creek at Cheltenham, Pa. J. N. Jacobs, controller.

Valparaiso, Ind.—July 2, 10 a. m. Constructing gravel roads in Morgan and West Chester counties. T. L. Blathly, auditor.

### CONTRACTS AWARDED.

Bloomington, Ill.—Constructing bridge over Funk's branch at Danvers, to the Porter-McCulley Construction Co., Mackinaw, Ill.

Hillsboro, Ill.—Constructing concrete bridge on line between Irving and East Fork townships, to G. E. Wiley, Irving, Ill.

Taylorville, Ill.—Constructing a bridge across the south fork of the Sangamon river, to Frank R. Miller, Springfield, Ill.

Bloomfield, Ind.—Constructing bridges in Green county, to the Vincennes Bridge Co., Vincennes, Ind., $14,400.

Newcastle, Ind.—Constructing 7 bridges in Henry county, to the Burk Construction Co., Newcastle, Ind., about $13,000.

Princeton, Ind.—The following bridge contracts have been awarded: Fifteen bridges, to Geo. Soller; 2 bridges to the Vincennes Bridge Co., Vincennes, Ind.; 2 bridges, to Wm. Eiglemann; 3 bridges, to J. A. Berger. The total cost of contracts let is $16,551.

Sullivan Ind.—Constructing 18 bridges to cost about $12,000, to the Sullivan Bridge & Supply Co., Sullivan, Ind.

Wabash, Ind.—Constructing the Beldon bridge, to the National Concrete Co., $12,997.

Council Bluffs, Ia.—Constructing 3 bridges, to the Lana Construction Co., Council Bluffs, Iowa.

Marshalltown, Ia.—Constructing four 17-ft. span reinforced concrete bridges, to the Capitol City Construction Co., Des Moines, Ia.

Kansas City, Kan.—Remodeling the West Kansas avenue bridge, to the Kansas City Bridge Co.

Louisville, Ky.—Constructing 2 bridges in Washington township, to the Attica Bridge Co., Attica, Ind.

Baltimore, Md.—Constructing a number of sewers, to Ryan & Reilly, $44,241.

Lincoln, Neb.—Constructing 2 state bridges, to Stutt Bros., St. Louis, Mo.

Albany, N. Y.—Constructing 5 superstructures and 1 substructure for highway bridges over the Erie canal, between Lyons and Palmyra, to the Owego Bridge Co., Owego, N. Y., $59,616.

Altoona, Pa.—The following bridge contracts have been awarded: Two arch bridges, to Edwin H. Brau, Hollidaysburg, Pa., $1,747, $1,992; concrete girder bridge, to Fogel & Co., $1,282; double arch bridge at Ironsville, to the Ferro Concrete Co., $9,495.

Altoona, Pa.—Constructing the steel span of the Seventh street bridge, to the Penn. Bridge Co., Beaver Falls, Pa., $30,110.

New Castle, Pa.—The following bridge contracts have been awarded; Nine bridges, totaling $10,914, to the Farris Bridge Co.; 3 bridges, totaling $4,176, to the Nelson Meddith Co.

Osceola, Pa.—Constructing a bridge over Moshannon creek, to Geo. I. Thompson, Clearfield, Pa., $7,883.

### CONTEMPLATED WORK.

Maywood, Ill.—Proviso township has voted a $20,000 bond issue for bridge construction.

Quincy, Ill.—The county supervisors have appropriated $14,939 for bridge construction. Ed. Miller, supervisor.

Fullerton, Ky.—Plans and specifications have been prepared for the construction of 4 bridges in Greenup county.

Baton Rouge, La.—A company has been incorporated for $1,000,000 to build a terminal station and a bridge across the Mississippi River. The incorporators are Hugh Chamberlain, Baton Rouge; Jos. E. Hedges, New York City; L. F. Stuart, Kansas City, Mo.; Walter Bynum, Baton Rouge; W. P. Chamberlain, New Orleans; and E. B. McQuety, Baton Rouge.

Meridian, Miss.—A $30,000 bond issue for the construction of a railroad viaduct has been voted. C. W. O'Leary, city clerk.

Medford, Ore.—A $20,000 bond issue for bridge construction has been voted. E. B. Foss, city recorder.

Bay City, Tex.—The United States government has appropriated $12,000 for the constructing of two bridges over the Intercostal Canal.

## GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

### CONTRACTS AWARDED.

Atlanta, Ga.—Constructing a garbage disposal plant to the Heenan Destructor Co., thru their southern headquarters at Birmingham, Ala., $376,800.

Boston, Mass.—Constructing refuse receiving station at South street, to Lawler Bros., $71,333.

### CONTEMPLATED WORK.

Iowa City, Ia.—The city desires to purchase a street flushing machine. James W. Berry, engineer.

Hagerstown, Md.—The Board of Trade is discussing the installation of a garbage disposal system.

Erie, Pa.—Street Superintendent Tracy has requested four additional street flushing wagons.

Philadelphia, Pa.—Specifications are being prepared for street cleaning, garbage collection, gasoline lighting contracts for 1913. Bids will be requested soon. Morris L. Cooke, director of public works.

Morgantown, W. Va.—The city council has authorized the purchase of a site for the proposed garbage incinerating plant.

## STREET LIGHTING.

### CONTEMPLATED WORK.

Jacksonville, Fla.—The installation of an ornamental lighting system for Hogan street is contemplated. F. W. Bucky, improvement association of Hogan street.

Burley, Ida.—An $85,000 bond issue for a water and sewerage system and for extending the electric lighting and heating system has been voted.

Dow City, Ia.—A $5,000 bond issue has been voted for electric light improvement. E. T. Higgins, town clerk.

Marshalltown, Ia.—A public utility franchise for gas, electricity and the operation of street cars has been awarded to Col. William Dows, Isaac B. Smith, John A. Reed and R. S. Cook, of Cedar Rapids.

Moville, Ia.—A $7,800 bond issue for the construction of a municipal lighting plant has been voted. W. H. Rockefeller, city clerk.

Axtell, Kas.—A $10,000 bond issue for electric light plant construction has been voted. T. M. Fabor, city clerk.

Osawatomie, Kas.—A $20,000 bond issue for the construction of an electric light plant has been voted.

Osborne, Kas.—A $15,000 bond issue for the constructon of a municipal light plant has been voted.

Olivet, Mich.—The village is contemplating letting a contract to the Commonwealth Power Co., for the lighting of the streets. Ellsworth Long, village president.

Bethany, Mo.—A $25,000 bond issue for the construction of an electric light plant has been voted. J. D. McClure, city clerk.

Millville, N. J.—The city council has voted to retain a consulting engineer to have charge of the construction of a municipal light plant.

Lockport, N. Y.—The installation of an ornamental lighting system on Main street is contemplated. Address Pres. John Moon, of the Chamber of Commerce.

Northwood, N. D.—An $8,000 bond issue for electric light improvement has been voted.

Philadelphia, Pa.—Specifications are being prepared for street cleaning, garbage collection and gasoline lighting contracts for 1913. Bids will be requested soon. Morris L. Cooke, director of public works.

Sharon, Pa.—An $85,000 bond issue for the construction of a municipal electric light plant has been voted.

Columbia, S. C.—The installation of an ornamental lighting system on West Main street is contemplated. R. C. Keenan, councilman.

Palestine, Tex.—The Young Men's Business League are planning an ornamental lighting system for the city.

Danville, Va.—A $150,000 bond issue for the construction of an electric light plant has been voted.

## FIRE APPARATUS.

### CONTEMPLATED WORK.

Talladega, Ala.—The purchase of motor fire apparatus is contemplated.

Alameda, Cal.—The city clerk has been instructed to advertise for bids for an auto tractor for use on a hook and ladder truck.

San Diego, Cal.—A. D. Dobson, superintendent of the fire department, is preparing an ordinance for the purchase of four automobile chemical wagons.

Santa Clara, Cal.—The city will purchase a combination water, chemical and hose wagon.

Sterling, Ill.—Plans and specifications for an automobile fire truck has been prepared.

Caldwell, Ida.—A $10,000 bond issue has been voted for the purchase of fire apparatus.

Peru, Ind.—T. Dunn, city clerk, has been instructed to secure bids for motor fire apparatus.

Waltham, Miss.—A $6,000 appropriation was made for the purchase of motor fire apparatus.

Winchester, Mass.—The purchase of motor fire apparatus is contemplated.

Grand Rapids, Mich.—The board of police and fire commissioners will advertise for bids on motor fire apparatus, including two automobile hose wagons, a motor drive tractor and an automobile for the fire marshal.

St. Paul, Minn.—The purchase of a motor driven fire engine is contemplated.

St. Joseph, Mo.—Alfred Meier, president of the board of public works, has recommended a bond issue for the purchase of motor fire apparatus.

Tekamah, Neb.—The council has voted to add a motor propelled chemical engine to their fire equipment.

Mansfield, O.—The director of public service will advertise for bids for motor fire apparatus.

Mansfield, O.—The director of public service has been instructed to secure bids for a motor combination hose and chemical car. Geo. Knofflock, chief of fire department.

Oklahoma City, Okla.—The purchase of an automobile chemical car is contemplated.

West Chester, Pa.—The city is contemplating the purchase of an automobile fire engine and other motor apparatus.

Abilene, Tex.—A $10,000 bond issue for fire equipment has been voted.

Fort Worth, Tex.—The purchase of two automobile pumping engines is contemplated.

Milwaukee, Wis.—An ordinance has been prepared providing for the purchase of two combination hose and chemical automobiles. Thomas A. Clancy, chief of fire department.

Superior, Wis.—The purchase of a number of motor propelled fire engines is contemplated. Mayor Konkel.